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## PATENT ABSTRACTS OF JAPAN

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(72)Inventor : IKEDA KOJI  
SHIBATA KAZUYOSHI

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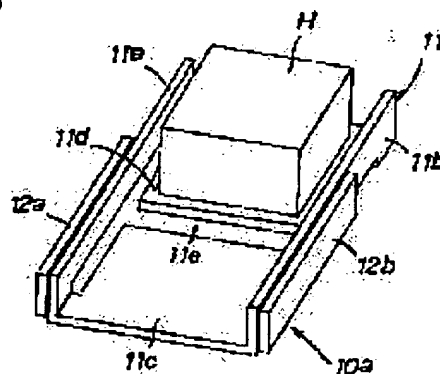
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## (54) PIEZOELECTRIC/ELECTROSTRICTION DEVICE AND MANUFACTURING METHOD THEREFOR

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce the number of parts of a piezoelectric/electrostriction device, which comprises a base body 11 provided with a pair of left and right, movable parts 11a and 11b by a fixed part 11c on its one end side, and piezoelectric/ electrostriction elements 12a and 12b provided on the side surface of the movable parts 11a and 11b of the base body.

SOLUTION: An integrated base body 11 is employed as the base body of a piezoelectric/electrostriction device, where an original plate punched into such a shape of flatly developed base body is bent, to provide the piezoelectric/ electrostriction device with few number of parts.



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## CLAIMS

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### [Claim(s)]

[Claim 1] The base which has the fixed part which connects mutually the moving part and both [ these ] the moving part of a Uichi Hidari pair at an end section side, They are the piezo-electricity / electrostriction device possessing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base. They are the piezo-electricity / electrostriction device which said base consists of plates of one sheet, and said fixed part presents plate-like, and is characterized by for said each moving part having done predetermined height standing up from each side edge section of said fixed part, having countered mutually, and having extended exceeding the other end of this fixed part along with each side edge section of a fixed part.

[Claim 2] The piezo-electricity / electrostriction device characterized by the slit-like slot which extends from the other end side of this fixed part intervening in piezo-electricity / electrostriction device according to claim 1 between the side edge sections of the base of each moving part which constitutes said base, and said fixed part.

[Claim 3] The base which has the fixed part which connects the moving part of a Uichi Hidari pair, and both [ these ] moving part of each other [ in an end section side ], and the attachment section which connected both [ these ] moving part of each other [ in an other end side ], and has been separated mutually [ said fixed part ], They are the piezo-electricity / electrostriction device possessing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base. Said base consists of plates of one sheet, and said stationary plate and said tie-down plate present plate-like. Said each moving part The piezo-electricity / electrostriction device which carries out predetermined height standing up from each side edge section of said fixed part and said attachment section, and is characterized by having countered mutually and having extended along with each side edge section of this fixed part and said attachment section.

[Claim 4] The piezo-electricity / electrostriction device characterized by for the slit-like slot which extends in a longitudinal direction intervening in piezo-electricity / electrostriction device according to claim 3 between the end sections of the other end of said fixed part which constitutes said base, and said attachment section, and the slit-like slot which extends in a lengthwise direction intervening between the side edge sections of the base of each of said moving part, said fixed part, and said attachment section.

[Claim 5] The piezo-electricity / electrostriction device characterized by the slot of the shape of a rectangle prolonged in a longitudinal direction and a lengthwise direction intervening in piezo-electricity / electrostriction device according to claim 3 between the end sections of the other end of said fixed part which constitutes said base, and said attachment section.

[Claim 6] The fixed part which connects the moving part of a Uichi Hidari pair, and both [ these ] moving part of each other [ in an end section side ], The base which has the attachment section which connected both [ these ] moving part of each other [ in an other end side ], and has been separated mutually [ said fixed part ], and this attachment section and the connection section which surrounds this attachment section, said each moving part, and said fixed part by one, They are the piezo-electricity / electrostriction device possessing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base. Said base consists of plates of one sheet, and said stationary plate and said tie-down plate present plate-like. Said each moving part Carry out predetermined height standing up from each side edge section of said fixed part and said attachment section, counter mutually, and it extends along with each side edge section of this fixed part and said attachment section. And said each moving part, said fixed part, and said attachment section are the piezo-electricity / electrostriction device characterized by being located in the central space circles of said connection section.

[Claim 7] They are the piezo-electricity / electrostriction device characterized by the end section side of said fixed part in said central space section of said connection section being in a closing condition in piezo-electricity / electrostriction device according to claim 6.

[Claim 8] They are the piezo-electricity / electrostriction device characterized by the end section side of said fixed part in said central space section of said connection section being in an open condition in piezo-electricity / electrostriction device according to claim 6.

[Claim 9] The connection section between each side edge section of the base of each of said moving part which constitutes said base in piezo-electricity / electrostriction device according to claim 1 or 2, and said fixed part is the piezo-electricity / electrostriction device characterized by presenting the shape of radii.

[Claim 10] The connection section between each side edge section of the base of each of said moving part which constitutes said base in piezo-electricity / electrostriction device according to claim 3, 4, 5, 6, 7, 8, or 9, said fixed part, and said attachment section is the piezo-electricity / electrostriction device characterized by presenting the shape of radii.

[Claim 11] Said each moving part which constitutes said base in piezo-electricity / electrostriction device according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 is the piezo-electricity / electrostriction device characterized by forming at least the pars intermedia of the die-length direction thinly as compared with other parts.

[Claim 12] Said each moving part which constitutes said base in piezo-electricity / electrostriction device according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 11 is the piezo-electricity / electrostriction device characterized by providing the reinforcement section which is crooked and prolonged at the edge by the side of said fixed part from the upper limb of this edge, and contacts it on the front face of said fixed part.

[Claim 13] Said each moving part which constitutes said base in piezo-electricity / electrostriction device according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 11 is the piezo-electricity / electrostriction device characterized by providing the reinforcement section which is crooked at the edge by the side of said fixed part from the edge of this edge, is prolonged at it to the inside, and contacts it on the front face of said fixed part.

[Claim 14] The piezo-electricity / electrostriction device characterized by the reinforcement member intervening in piezo-electricity / electrostriction device according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 11 among said each moving part in said fixed part which constitutes said base.

[Claim 15] Said fixed part which constitutes said base in piezo-electricity / electrostriction device given in claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, or 14 is the piezo-electricity / electrostriction device characterized by having extended from the end section side of each of said moving part, and being expanded as compared with the case where it is located in said each moving part.

[Claim 16] Said attachment section which constitutes said base in piezo-electricity / electrostriction device according to claim 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, or 14 is the piezo-electricity / electrostriction device characterized by having extended from the other end side of each of said moving part, and being expanded as compared with the case where it is located in said each moving part.

[Claim 17] They are the piezo-electricity / electrostriction device characterized by said base consisting of metal plates in piezo-electricity / electrostriction device given in claims 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, or 16.

[Claim 18] The base which has the fixed part which connects mutually the moving part and both [ these ] the moving part of a Uichi Hidari pair at an end section side, It is the approach of manufacturing the piezo-electricity / electrostriction device possessing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base. The possible plate of crookedness processing by flexibility is adopted as a formation ingredient of said base. This plate The manufacture approach of of the piezo-electricity / electrostriction device characterized by piercing and processing said base into the configuration developed to the plane, forming the punching structure, and forming the base which is crooked in the predetermined part of this punching structure, and has said each moving part and said fixed part.

[Claim 19] In the manufacture approach of of piezo-electricity / electrostriction device according to claim 18 said punching structure It has opening of the portal configuration which consists of notching \*\*\*\* opening the part between the side slot of the shape of a straight line of the pair prolonged along with the side edge section in the flank of rectangular monotonous right and left, and both [ these ] slots. The manufacture approach of of the piezo-electricity / electrostriction device characterized by forming the part between the side and said each slot in said fixed part while forming said each side edge section in said each moving part by carrying out crookedness processing of said each monotonous side edge section along said side slot.

[Claim 20] The base which has the fixed part which connects the moving part of a Uichi Hidari pair, and both [ these ] moving part of each other [ in an end section side ], and the attachment section which connected both [ these ] moving part of each other [ in an other end side ], and has been separated mutually [ said fixed part ], It is the approach of manufacturing the piezo-electricity / electrostriction device possessing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base. The possible plate of crookedness processing

by flexibility is adopted as a formation ingredient of said base. This plate The manufacture approach of of the piezo-electricity / electrostriction device characterized by piercing and processing said base into the configuration developed to the plane, forming the punching structure, and forming the base which is crooked in the predetermined part of this punching structure, and has said each moving part and said fixed part.

[Claim 21] In the manufacture approach of of piezo-electricity / electrostriction device according to claim 20 said punching structure It has opening of H configuration which consists of a central slot of the shape of a straight line which connects mutually straight-line-like the side slot and the method slot of these both sides of the pair prolonged along with the side edge section in the flank of rectangular monotonous right and left in pars intermedia. The manufacture approach of of the piezo-electricity / electrostriction device characterized by forming the part between the side and said each slot in said fixed part and said attachment section while forming said each side edge section in said each moving part by carrying out crookedness processing of said each monotonous side edge section along said side slot.

[Claim 22] By said punching structure's having rectangular opening in the rectangular monotonous center section, and carrying out crookedness processing of said each monotonous side edge section along with the side edge section of said opening in the manufacture approach of of piezo-electricity / electrostriction device according to claim 20 The manufacture approach of of the piezo-electricity / electrostriction device characterized by forming the part between the side and said each slot in said fixed part and said attachment section while forming said each side edge section in said each moving part.

[Claim 23] The fixed part which connects the moving part of a Uichi Hidari pair, and both [ these ] moving part of each other [ in an end section side ], The base which has the attachment section which connected both [ these ] moving part of each other [ in an other end side ], and has been separated mutually [ said fixed part ], and this attachment section and the connection section which surrounds this attachment section, said each moving part, and said fixed part by one, It is the approach of manufacturing the piezo-electricity / electrostriction device possessing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base. The possible plate of crookedness processing by flexibility is adopted as a formation ingredient of said base. This plate The manufacture approach of of the piezo-electricity / electrostriction device characterized by piercing and processing said base into the configuration developed to the plane, forming the punching structure, and forming the base which is crooked in the predetermined part of this punching structure, and has said each moving part, said fixed part, said attachment section, and said connection section.

[Claim 24] In the manufacture approach of of piezo-electricity / electrostriction device according to claim 23, while said punching structure has the rectangular monotonous section inside rectangular monotonous central opening It has opening of H configuration which consists of a central slot of the shape of a straight line which connects mutually straight-line-like the side slot and the method slot of these both sides of the pair prolonged along with the side edge section in the flank of right and left of this monotonous section in pars intermedia. By carrying out crookedness processing along said side slot, each side edge section of said monotonous section The manufacture approach of of the piezo-electricity / electrostriction device characterized by forming said each side edge section in said each moving part, and forming the part between the side and said each slot in said fixed part and said attachment section, and forming the part of the periphery of said central opening in said connection section.

[Claim 25] It is the manufacture approach of of the piezo-electricity / electrostriction device characterized by carrying out by piercing opening of said punching structure to said monotonous blanking processing and coincidence in the manufacture approach of of piezo-electricity / electrostriction device according to claim 18, 19, 20, 21, 22, 23, or 24, and being formed, or being formed in the perforating process after said monotonous blanking processing.

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to piezo-electricity / electrostriction device.

[0002]

[Description of the Prior Art] As one format of piezo-electricity / electrostriction device, as indicated by the European Patent (EP 1017116A2) specification The base which has the fixed part which connects mutually the moving part and both [ these ] the moving part of a Uichi Hidari pair at an end side, The piezo-electricity / electrostriction device of the format of providing the piezo-electricity / electrostriction component which it comes to arrange in one [ at least ] side face of said both moving part of this base, The base which has the fixed part which connects the moving part of a Uichi Hidari pair, and both [ these ] moving part of each other [ in an end section side ], and the attachment section which connects both [ these ] moving part of each other [ in an other end side ], There are piezo-electricity / an electrostriction device of the format of providing the piezo-electricity / electrostriction component which it comes to arrange in one [ at least ] side face of said both moving part of this base.

[0003] The piezo-electricity / electrostriction device of the format concerned have the actuation function of the moving part resulting from displacement actuation of piezo-electricity / electrostriction component, or the detection function in which piezo-electricity / electrostriction component detects the variation rate of moving part inputted from a detected side, and is used for the large application like the following, using these functions effectively.

[0004] That is, the piezo-electricity / electrostriction device of the format concerned are used for the various actuators used for the variation rate of various precision components, such as various sensor components, such as active elements, such as various transducers, various actuators, a frequency-domain functional article (filter), a transformer, an object for a communication link, the trembler for power and a resonator, a radiator, and a discriminator, an ultrasonic sensor, an acceleration sensor, an angular-velocity sensor, an impact sensor, and a mass sensor, an optical instrument and a precision mechanical equipment, etc., or the device of positioning adjustment and include-angle adjustment

[0005] By the way, by the piezo-electricity / electrostriction device of the format concerned cutting device original recording in proper magnitude generally, and being formed, device original recording pastes up piezo-electricity / electrostriction component through adhesives on front flesh-side both sides of base original recording, and is constituted, or these are formed in one and it is constituted. In addition, base original recording carries out the laminating of the sheet of two or more sheets, calcinates, and is constituted.

[0006]

[Problem(s) to be Solved by the Invention] Thus, there are many components mark of the component part, assembly operation is troublesome [ device ] while the piezo-electricity / electrostriction device of the format concerned have high cost, and since it has pasted up each component parts through adhesives, variation arises in adhesion of each component parts, and it has a possibility of affecting a device property.

[0007] Moreover, it is polluted by organic components, such as dust generated at the time of cutting, cutting fluid, adhesives further used in order to hold device original recording at the time of cutting, and a wax, and washing of piezo-electricity / electrostriction device is not easy for the piezo-electricity / electrostriction device cut and formed from the means which cuts device original recording suitably and picks a large number being taken in order to form the piezo-electricity / electrostriction device of the format concerned.

[0008] Moreover, since the ceramics tends to break when it constitutes a base from ceramics, even when it is necessary to adopt the ceramics of the hard quality of the materials, such as a zirconia, and the ceramics of a hard ingredient is adopted, it is necessary to select suitable cutting conditions so that neither a deficit nor a crack may occur. Moreover, in order to be hard to process a base from being the ceramics of a hard ingredient and to increase the processing number of

processing, it is necessary to consider using many processing equipments of a different function etc.

[0009] Although it is also possible to constitute a base from a metallic material, a metallic material must add another process which removes these, in order that an end face may oxidize with frictional heat during cutting or weld flash may remain to a processing end face. Moreover, if inspection of piezo-electricity / electrostriction component is not after cutting device original recording, it will be impossible.

[0010] Moreover, although it is desirable that dirt adopts ultrasonic cleaning which can be removed easily as washing of the device cut down from device original recording, when a powerful supersonic wave is used in order to mention a cleaning effect in ultrasonic cleaning, a damage may be given to a device, and piezo-electricity / electrostriction component may exfoliate from a base, or may be damaged. For this reason, although it is necessary to select the weak supersonic wave which does not give a damage to a device to adopt ultrasonic cleaning, when adopting such washing conditions, long duration will be required for removing the dirt which adheres at the time of cutting.

[0011] When the raising dust of it is carried out while driving the raising dust from piezo-electricity / electrostriction device, when using piezo-electricity / electrostriction device for the actuator of the magnetic head of a hard disk drive, the dust becomes a surfacing slider and the cause of crash of media, and it has a possibility of destroying data. Moreover, there is a possibility of the dust adhering to the electrode of piezo-electricity / electrostriction component, and causing short-circuit also to the piezo-electricity / the electrostriction device itself. For this reason, as opposed to a hard disk drive, whenever [ high defecation ] is required of the device itself.

[0012] Therefore, the purpose of this invention is by making the base which constitutes the piezo-electricity / electrostriction device of the format concerned into the integral construction which uses the plate of one sheet as a negative to solve each above-mentioned problem.

[0013]

[Means for Solving the Problem] The piezo-electricity / electrostriction device which this invention requires for this invention about the manufacture approach of of piezo-electricity / electrostriction device, and a piezo-electricity / electrostriction device are the piezo-electricity / electrostriction device of three kinds of following formats.

[0014] The piezo-electricity / electrostriction device of the 1st format concerning this invention are the piezo-electricity / electrostriction device possessing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of the base which has the fixed part which connects mutually the moving part and both [ these ] the moving part of a right-and-left pair at an end section side, and this base.

[0015] Moreover, the piezo-electricity / electrostriction device of the 2nd format concerning this invention The base which has the fixed part which connects the moving part of a Uichi Hidari pair, and both [ these ] moving part of each other [ in an end section side ], and the attachment section which connected both [ these ] moving part of each other [ in an other end side ], and has been separated mutually [ said fixed part ], They are the piezo-electricity / electrostriction device possessing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base.

[0016] Moreover, the piezo-electricity / electrostriction device of the 3rd format concerning this invention The fixed part which connects the moving part of a Uichi Hidari pair, and both [ these ] moving part of each other [ in an end section side ], The base which has the attachment section which connected both [ these ] moving part of each other [ in an other end side ], and has been separated mutually [ said fixed part ], and this attachment section and the connection section which surrounds this attachment section, said each moving part, and said fixed part by one, They are the piezo-electricity / electrostriction device possessing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base.

[0017] A deer is carried out, and in the piezo-electricity / electrostriction device of the 1st format concerning this invention, said base consists of plates of one sheet, said fixed part presents plate-like, said each moving part does predetermined height standing up from each side edge section of said fixed part, and it is characterized by having countered mutually and having extended exceeding the other end of this fixed part along with each side edge section of a fixed part.

[0018] In the piezo-electricity / the electrostriction device concerned, it can consider as the configuration between which it is placed by the slit-like slot which extends from the other end side of this fixed part between the side edge sections of the base of each moving part which constitutes said base, and said fixed part. Moreover, in the piezo-electricity / the electrostriction device concerned, the connection section between each side edge section of the base of each of said moving part which constitutes said base, and said fixed part can be considered as the configuration which presents the shape of radii.

[0019] In the piezo-electricity / electrostriction device of the 2nd format concerning this invention, it consists of plates of said one base, said stationary plate and said tie-down plate present plate-like, said each moving part does

predetermined height standing up from each side edge section of said fixed part and said attachment section, and it is characterized by having countered mutually and having extended along with each side edge section of this fixed part and said attachment section.

[0020] In the piezo-electricity / the electrostriction device concerned, the slit-like slot which extends in a longitudinal direction intervenes between the end sections of the other end of said fixed part which constitutes said base, and said attachment section. And it can consider as the configuration between which it is placed by the slit-like slot which extends in a lengthwise direction between the side edge sections of the base of each of said moving part, said fixed part, and said attachment section. Moreover, between the end sections of the other end of said fixed part which constitutes said base, and said attachment section, it can consider as the configuration between which it is placed by the slot of the shape of a rectangle prolonged in a longitudinal direction and a lengthwise direction. In the piezo-electricity / the electrostriction device concerned, the connection section between each side edge section of the base of each of said moving part which constitutes said base, and said fixed part can be considered as the configuration which presents the shape of radii further again.

[0021] In the piezo-electricity / electrostriction device of the 3rd format concerning this invention Said base consists of plates of one sheet, and said stationary plate and said tie-down plate present plate-like. Said each moving part It is characterized by carrying out predetermined height standing up from each side edge section of said fixed part and said attachment section, countering mutually, and extending along with each side edge section of this fixed part and said attachment section, and locating said each moving part, said fixed part, and said attachment section in the central space circles of said connection section.

[0022] In the piezo-electricity / the electrostriction device concerned, the end section side of said fixed part in said central space section of said connection section can be taken as the configuration in a closing condition or an open condition. Moreover, in the piezo-electricity / the electrostriction device concerned, the connection section between each side edge section of the base of each of said moving part which constitutes said base, and said fixed part can be considered as the configuration which presents the shape of radii.

[0023] The further following configuration can be taken in the piezo-electricity / electrostriction device of these formats concerning this invention. Namely, constituting said base on the metal plate of one sheet, the configuration which forms thinly at least the pars intermedia of the die-length direction of each of said moving part which constitutes the substrate concerned as compared with other parts, The configuration possessing the reinforcement section which is crooked and prolonged at the edge by the side of said fixed part of each of said moving part which constitutes said base from the upper limb of this edge, and contacts it on the front face of said fixed part, It can consider as the configuration possessing the reinforcement section which is crooked from the edge of this edge at the edge by the side of said fixed part of each of said moving part which constitutes said base, is prolonged to the inside at it, and contacts the front face of said fixed part at it, and the configuration between which a reinforcement member is made to be placed among said each moving part in said fixed part which constitutes said base. Moreover, it can extend from the other end side of each of said moving part, and the configuration to which said fixed part which constitutes said base is made to expand as compared with the case where extend from the end section side of each of said moving part, and it is located in said each moving part, and said attachment section which constitutes said base can be considered as the configuration to which it is made to expand as compared with the case where it is located in said each moving part.

[0024] Moreover, the manufacture approach of of the piezo-electricity / electrostriction device concerning this invention is an approach of manufacturing the piezo-electricity / electrostriction device of three kinds of above-mentioned formats, respectively, and the manufacture approach of of the piezo-electricity / electrostriction device of various formats is shown below.

[0025] The 1st manufacture approach concerning this invention is an approach of manufacturing the piezo-electricity / electrostriction device of the 1st format concerning this invention. The possible plate of crookedness processing by flexibility is adopted as a formation ingredient of said base. This plate It is characterized by piercing and processing said base into the configuration developed to the plane, forming the punching structure, and forming the base which is crooked in the predetermined part of this punching structure, and has said each moving part and said fixed part.

[0026] As a configuration which has opening of the portal configuration which consists of notching \*\*\*\* opening the part between the side slot of the shape of a straight line of the pair prolonged along with the side edge section in said punching structure in the flank of rectangular monotonous right and left, and both [ these ] slots in the manufacture approach concerned While forming said each side edge section in said each moving part by carrying out crookedness processing of said each monotonous side edge section along said side slot, the part between the side and said each slot can be formed in said fixed part.

[0027] The 2nd manufacture approach concerning this invention is an approach of manufacturing the piezo-electricity /



electrostriction device of the 2nd format concerning this invention. The possible plate of crookedness processing by flexibility is adopted as a formation ingredient of said base. This plate It is characterized by piercing and processing said base into the configuration developed to the plane, forming the punching structure, and forming the base which is crooked in the predetermined part of this punching structure, and has said each moving part and said fixed part.

[0028] As a configuration which has opening of H configuration which consists of a central slot of the shape of a straight line which connects mutually straight-line-like the side slot and the method slot of these both sides of the pair prolonged along with the side edge section in said punching structure in the flank of rectangular monotonous right and left in the manufacture approach concerned in pars intermedia While forming said each side edge section in said each moving part by carrying out crookedness processing of said each monotonous side edge section along said side slot, the part between the side and said each slot can be formed in said fixed part and said attachment section. Moreover, in the manufacture approach concerned, while forming said each side edge section in said each moving part by carrying out crookedness processing of said each monotonous side edge section along with the side edge section of said opening as a configuration which has rectangular opening for said punching structure in the rectangular monotonous center section, the part between the side and said each slot can be formed in said fixed part and said attachment section.

[0029] The 3rd manufacture approach concerning this invention is an approach of manufacturing the piezo-electricity / electrostriction device of the 3rd format concerning this invention. The possible plate of crookedness processing by flexibility is adopted as a formation ingredient of said base. This plate It is characterized by piercing and processing said base into the configuration developed to the plane, forming the punching structure, and forming the base which is crooked in the predetermined part of this punching structure, and has said each moving part, said fixed part, said attachment section, and said connection section.

[0030] While making said punching structure into the configuration which has the rectangular monotonous section inside rectangular monotonous central opening in the manufacture approach concerned As a configuration which has opening of H configuration which consists of a central slot of the shape of a straight line which connects mutually straight-line-like the side slot and the method slot of these both sides of the pair prolonged along with the side edge section in the flank of right and left of this monotonous section in pars intermedia By carrying out crookedness processing of each side edge section of said monotonous section along said side slot, said each side edge section is formed in said each moving part, and the part between the side and said each slot is formed in said fixed part and said attachment section, and the part of the periphery of said central opening can be formed in said connection section.

[0031] In each manufacture approach concerning this invention, a metal plate is adopted as a formation ingredient of said substrate, and opening of said punching structure is pierced, carried out and formed in said monotonous blanking processing and coincidence, or it can form in the perforating process after said monotonous blanking processing.

[0032]

[Function and Effect of the Invention] On a working principle, since these are really fabricated while to connect closely a fixed part or a fixed part, and the attachment section with the two side edge sections which have flexibility is needed, the piezo-electricity / electrostriction device concerning this invention have embodied the most desirable gestalt on a working principle.

[0033] For example, when two or the three above-mentioned important sections are welded as metal, the problem in heat treatment processes, such as distortion by the heat of joining, quality-of-the-material degradation, and annealing, must be taken into consideration. On the other hand, even if this of what is really depended on shaping like a constituting-piezo-electricity / electrostriction device concerning this invention base is metal, these concern does not exist and can also really expect improvement in the reinforcement of the connection section by work hardening at the time of shaping.

[0034] In the piezo-electricity / electrostriction device concerning this invention, since the sum of the height of components and the height of a device becomes lower than this, without becoming the height after assembly when it combines with components (for example, magnetic head of a hard disk drive), there is an advantage which can be considered as a compact configuration. In the height of a device, although the amount of [ a part for the thickness of the plate of moving part and / of adhesives ] thickness joins the height of components, as compared with the well-known device described at the beginning, the height after assembly can be made low, and there is effectiveness of space-saving-izing. Moreover, since assembly can be simply done only by pasting up components on a fixed part and a large adhesion area can be taken, there is an advantage which can strengthen bond strength more and can be made into the structure which cannot drop out easily due to an impact.

[0035] In the 1st [ of the piezo-electricity / the electrostriction devices concerning this invention ], and 2nd piezo-electricity / electrostriction device, it is easy at least for the attachment section and jointing to the jointing-ed article of a fixed part on the structure to form the hollow containing adhesives with a press, thereby, bond strength can be made to

be able to increase or the flash of adhesives can be controlled. Moreover, it is also easy to form the criteria locations for positioning (hole etc.) used in the case of subassembly. For this reason, components can be assembled in the attachment section on a device, or the assembly precision at the time of attaching a fixed part in the gimbal of a suspension can be raised at a back process, and the yield can be raised further. By inspecting piezo-electricity / electrostriction component beforehand, and assembling it, before assembling a device, the poor property of the device after assembly can be reduced sharply.

[0036] Moreover, in the piezo-electricity / electrostriction device of the 3rd format concerning this invention, although the operation effectiveness which the 1st and 2nd piezo-electricity / electrostriction device have can be done so of course, it has the attachment section and the connection section of one, and there is a big advantage that the connection section concerned can be operated as a gimbal which supports the magnetic head (slider) of a hard disk drive, especially.

[0037] The piezo-electricity / electrostriction device concerning this invention are set to the piezo-electricity / electrostriction device of such basic structures on the basis of the piezo-electricity / electrostriction device of three kinds of above-mentioned formats. Since any base is the thing of the integral construction which uses a plate as a negative and consists of one component part in principle, while a component part becomes a base and two kinds such as piezo-electricity / electrostriction component and being able to reduce sharply the component part of piezo-electricity / electrostriction device The man day with a group of a component part can be reduced, and cost can be mitigated sharply.

[0038] Moreover, in the piezo-electricity / electrostriction device of each format concerning this invention, since there are very few components mark of a component part and there are also in jointing of each component parts, the variation in adhesion of each component parts has a nil or device property with a high precision which is not almost and was set up. [ very few ]

[0039] Moreover, in each piezo-electricity / electrostriction device concerning this invention, if it is in the formation, there is no contamination by the dust which does not take a means to cut device original recording by many parts, and is generated at the time of cutting of device original recording, or other contaminations. For this reason, beforehand, in case piezo-electricity / electrostriction device is assembled, if the base, and the piezo-electricity / electrostriction component are washed, with the formed piezo-electricity / electrostriction device, there is there being no contamination or an advantage which is not almost, and can omit washing of piezo-electricity / electrostriction device, or can be finished easily.

[0040] In the piezo-electricity / electrostriction device concerning this invention, it can manufacture respectively easily and at a low price by the 3rd manufacture approach which starts this invention by the 2nd manufacture approach which starts this invention by the 1st manufacture approach which starts this invention if it is in the piezo-electricity / electrostriction device of the 1st format if it is in the piezo-electricity / electrostriction device of the 2nd format if it is in the piezo-electricity / electrostriction device of the 3rd format.

[0041]

[Embodiment of the Invention] The base which has the fixed part with which the piezo-electricity / electrostriction device concerning this invention connect mutually the moving part and both [ these ] the moving part of a right-and-left pair at an end section side, The piezo-electricity / electrostriction device of the 1st format of providing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base, The base which has the fixed part which connects the moving part of a Uichi Hidari pair, and both [ these ] moving part of each other [ in an end section side ], and the attachment section which connected both [ these ] moving part of each other [ in an other end side ], and has been separated mutually [ said fixed part ], The piezo-electricity / electrostriction device of the 2nd format of providing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base, And the fixed part which connects the moving part of a right-and-left pair, and both [ these ] moving part of each other [ in an end section side ], The base which has the attachment section which connected both [ these ] moving part of each other [ in an other end side ], and has been separated mutually [ said fixed part ], and this attachment section and the connection section which surrounds this attachment section, said each moving part, and said fixed part by one, They are the piezo-electricity / electrostriction device of the 3rd format of providing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of said both moving part of this base. Many operation gestalten (operation gestalt [ of \*\* a 1st ] - 11th operation gestalt) of the piezo-electricity / electrostriction device of each format are shown in drawing 1 .

[0042] The 1st piezo-electricity / electrostriction device 10a shown in drawing 1 (a) belong under the category of the piezo-electricity / electrostriction device of the 2nd format concerning this invention, and is used in the condition which shows in drawing 2 . The 1st piezo-electricity / electrostriction device 10a is formed by the approach shown in drawing

3 and drawing 4. The 1st piezo-electricity / electrostriction device 10a is what consists of piezo-electricity / electrostriction components 12a and 12b of a base 11 and a pair. A base 11 It consists of plate-like fixed part 11c which connects the moving part 11a and 11b of a Uichi Hidari pair tabular [ long ], and both the moving part 11a and 11b of each other [ in an end section side ] with a narrow width, and 11d of the plate-like attachment sections which connect both the moving part 11a and 11b of each other [ in an other end side ].

[0043] In the base 11, each moving part 11a and 11b, fixed part 11c, and 11d of attachment sections are divided in opening 11e of H configuration. Opening 11e consisted of the side slot 11e1 of a right-and-left pair, 11e2, and the method slot 11e1 of these both sides and the central slot 11e3 which connects 11e2 mutually in the center section of the longitudinal direction, and left-hand side moving-part 11a was crooked along this slot 11e1 in the side slot 11e1, and has stood up in the rectangular condition to fixed part 11c and 11d of attachment sections. Similarly, right-hand side moving-part 11b was crooked along this slot 11e2 in the side slot 11e2, and has stood up in the rectangular condition to fixed part 11c and 11d of attachment sections.

[0044] The base 11 of this configuration is pasted through the adhesives with which each piezo-electricity / electrostriction components 12a and 12b become the lateral surface of each moving part 11a and 11b from an epoxy resin etc. Each piezo-electricity / electrostriction components 12a and 12b are multilayer objects which consist of piezo-electricity / an electrostriction layer, and an electrode layer, and each moving part 11a and 11b is the same configurations. It is short formed in predetermined length, pasted up in accordance with the edge by the side of fixed part 11c of each moving part 11a and 11b, and has extended to the part which left predetermined die length from the edge by the side of 11d of attachment sections of each moving part 11a and 11b.

[0045] In the base 11 concerned, it is pasted up and fixed, and in the inferior-surface-of-tongue side, magnetic-head H for hard disks (slider) which is for example, a control-section-ed article pastes the gimbal of a suspension, and is fixed to the top-face side of the fixed part 11c. In addition, the above can change the attaching position of magnetic-head H and a suspension into 11d of attachment sections, and fixed part 11c conversely in this case, and the function of a device does not change at all by this. Moreover, the attachment part to magnetic-head H, fixed part 11c of the attaching position of a suspension, and 11d of attachment sections can also be changed into table back reverse, and the function of a device does not change at all by this. However, it is necessary to wire conversely wiring of the external electrode in contact with the terminal area of piezo-electricity / electrostriction components 12a and 12b on a suspension.

[0046] The base 11 which carries out a deer and constitutes the piezo-electricity / the electrostriction device 10a concerned uses as a molding material negative 11A shown in drawing 3 (a), it is crooked and negative 11A is formed, as shown in this drawing (b). Negative 11A is the punching structure which pierces and comes to process the plate in which crookedness processing is possible by flexibility, and is formed in the configuration which developed the base 11 to the plane. As for the plate which constitutes negative 11A, it is desirable that it is metal in reinforcement.

[0047] As for a plate, it is desirable that Young's modulus is the metal of 100 or more GPas, and the martensitic stainless steel of the ferritic stainless steel of the austenitic stainless steel of SUS301, SUS304, AISI653, and SUH660 grade, SUS430, and SUS434 grade, SUS410, and SUS630 grade, SUS6312, the semi austenitic stainless steel of AISI632 grade, ERUMAJINGUSU ten loess steel, various spring steel steel materials, etc. can be mentioned as an iron system ingredient. Moreover, as a non-iron system ingredient, superelastic titanium alloys, such as a titanium-nickel alloy, brass, cupronickel, aluminum, a tungsten, molybdenum, beryllium copper, phosphor bronze, nickel, a ferronickel alloy, titanium, etc. can be mentioned.

[0048] Negative 11A pierces a plate, is attached and formed in processing, and possesses opening 11e of H configuration. Opening 11e is formed in coincidence at the time of monotonous blanking processing, and is set to the side slot 11e1 of the shape of a straight line of the pair prolonged in each flank of right and left of negative 11A at an order both-ends side, and 11e2 from the method slot 11e1 of these both sides, and the central slot 11e3 of the shape of a straight line which connects 11e2 mutually in pars intermedia. The base 11 is formed by crooking each side edge section of right and left of negative 11A at a right angle in each side slot 11e1 and 11e2 along with the center lines L1 and L2 prolonged in the longitudinal direction in this slot 11e1 and the core of the width of face of 11e2. While each side slot 11e1 and the side edge part of 11e2 are formed in each moving part 11a and 11b by carrying out crookedness processing of each flank of right and left of negative 11A in this way, the part by the side of the front end section of the central slot 11e3 is formed in fixed part 11c, and the part by the side of the back end section is formed in 11d of attachment sections.

[0049] Thus, as shown in the base 11 constituted by negative 11A at one at drawing 4 (a), piezo-electricity / electrostriction components 12a and 12b are pasted up on the lateral surface of each of those moving part 11a and 11b through adhesives, and the piezo-electricity / electrostriction device 10a shown in this drawing (b) are formed. Since the base 11 consists of negative 11A in one while functioning as the piezo-electricity / electrostriction device of this

conventional seed format similarly, the formed piezo-electricity / electrostriction device 10a do the operation effectiveness like the following so.

[0050] Namely, it sets to the 1st piezo-electricity / electrostriction device 10a. From being the thing of the integral construction which a base 11 becomes only from negative of one sheet 11A, and consisting of one component part A component part can reduce the man day with a group of a component part sharply, and can mitigate cost sharply while it becomes a base 11 and two kinds such as piezo-electricity / electrostriction components 12a and 12b and can reduce sharply the component part of piezo-electricity / electrostriction device 10a.

[0051] Moreover, in the 1st piezo-electricity / electrostriction device 10a, since there are very few components mark of a component part and there are also in jointing of each component parts, the variation in adhesion of each component parts has a nil or device property with a high precision which is not almost and was set up. [ very few ]

[0052] Moreover, in the 1st piezo-electricity / electrostriction device 10a, if it is in the formation, the dust which does not take a means to cut device original recording by many parts, and is generated at the time of cutting of device original recording, and contamination resulting from adhesion of other contaminations are not like the former. For this reason, if a base 11, and the piezo-electricity / electrostriction components 12a and 12b are beforehand washed on the occasion of the assembly of the 1st piezo-electricity / electrostriction device 10a, there is almost nothing, and washing of piezo-electricity / electrostriction device 10a can be omitted, or the assembled piezo-electricity / electrostriction device 10a have that there is no contamination or the big advantage that it can finish easily.

[0053] The 2nd piezo-electricity / electrostriction device 10b shown in drawing 1 (b) belong under the category of the piezo-electricity / electrostriction device of the 2nd format concerning this invention. It is that in which, as for the 1st piezo-electricity / electrostriction device 10a, the 2nd piezo-electricity / electrostriction device 10b differs in the configuration of a base slightly. As shown in drawing 6 (b), it consists of piezo-electricity / electrostriction components 12a and 12b of a base 13 and a pair. A base 13 It consists of plate-like fixed part 13c which connects the moving part 13a and 13b of a Uichi Hidari pair tabular [ long ], and both the moving part 13a and 13b of each other [ in an end section side ] with a narrow width, and 13d of the plate-like attachment sections which connect both the moving part 13a and 13b of each other [ in an other end side ].

[0054] In a base 13, as far as each moving part 13a and 13b, fixed part 13c, and 13d of attachment sections are divided in opening 13e of H configuration and this configuration is concerned, it is the same configuration as the base 11 of the 1st piezo-electricity / electrostriction device 10a.

[0055] A deer is carried out and the flecion 13a1 which is a connection part to fixed part 13c of each moving part 13a and 13b and 13d of attachment sections, and 13b1 are presenting the shape of radii which became depressed from the fixed parts [ 13c and 13d ] front face in the base 13. As shown in drawing 5 (a), negative 13A which constitutes the base 13 concerned is the same as that of negative 11A of a base 11, and differs in the crookedness configuration at the time of carrying out crookedness formation of each moving part 13a and 13b. That is, in the crookedness processing concerned, the radii-like flecion 13a1 and 13b1 are formed in the base of each moving part 13a and 13b. As shown in the base 13 concerned at drawing 6 (a), the 2nd piezo-electricity / electrostriction device 10b is formed by pasting up each piezo-electricity / electrostriction components 12a and 12b on the lateral surface of each moving part 13a and 13b.

[0056] Although the 2nd piezo-electricity / electrostriction device 10b does so the same operation effectiveness as abbreviation while the 1st piezo-electricity / electrostriction device 10a has the same function Since each moving part 13a and 13b has connected with fixed part 13c and 13d of attachment sections through the radii-like flecion 13a1 and 13b1 especially, the each moving part [ 13c and 13d ] movability is improving, and it has a high device function.

[0057] moreover, the precision of plumbness [ on the 2nd piezo-electricity / the electrostriction device 10b concerned and as opposed to fixed part 13c of each moving part 13a and 13b, and 13d of attachment sections ] -- taking out -- easy -- carrying out -- the influence direction -- a variation rate can be stopped. Moreover, since it can set up by changing how the location of Y shaft orientations of each moving part 13a and 13b bends a radii-like flecion to fixed part 13c and 13d of attachment sections, the width of face of a design of a device can be expanded.

[0058] The 3rd piezo-electricity / electrostriction device 10c shown in drawing 1 (c) belong under the category of the piezo-electricity / electrostriction device of the 2nd format concerning this invention. Other configurations are the same although the 3rd piezo-electricity / electrostriction device 10c differs in few parts of the configuration of a base with the 2nd piezo-electricity / electrostriction device 10b.

[0059] A deer is carried out. The 3rd piezo-electricity / electrostriction device 10c As shown in drawing 8 (b), it is what consists of piezo-electricity / electrostriction components 12a and 12b of a base 14 and a pair. A base 14 It consists of plate-like fixed part 14c which connects the moving part 14a and 14b of a Uichi Hidari pair tabular [ long ], and both the moving part 14a and 14b of each other [ in an end section side ] with a narrow width, and 14d of the plate-like attachment sections which connect both the moving part 14a and 14b of each other [ in an other end side ].

[0060] In the base 14, although the pars intermedia of the longitudinal direction of each moving part 14a and 14b is formed in a thin-walled part 14a1 and 14b1 covering predetermined die length, if this point is removed, it is constituted identically to a base 13. Moreover, negative 14A of a base 14 is the thing which will constitute each moving part 14a and 14b and which possesses a thin-walled part 14a1 and 14b1 in each flank of right and left of opening 14e of H configuration, as shown in drawing 7 (a). it is alike, the two-dot chain lines L1 and L2 shown in drawing 7 (b) are met, crookedness processing is carried out like a base 13, and as shown in drawing 8 (a), the 3rd piezo-electricity / electrostriction device 10c is formed by pasting up each piezo-electricity / electrostriction components 12a and 12b on the lateral surface of each moving part 14a and 14b.

[0061] As for the 2nd piezo-electricity / electrostriction device 10b, the 3rd piezo-electricity / electrostriction device 10c has the device function in which the movability of each moving part 14a and 14b is still higher, and it is still higher since each moving part 14a and 14b possesses especially the thin-walled part 14a1 prolonged in the pars intermedia at a longitudinal direction, and 14b1 although the same operation effectiveness as abbreviation is done so while having the same function.

[0062] In addition, the approach of removing meat partially by chemistry ETCHING, micro blasting, ion milling, etc., and making thickness thin as the thin-walled part 14a1 of negative 14A and a means to form 14b1, the approach of cutting by grinding and making thickness thin, etc. can be taken. Moreover, as a special means, lamination of the plate which made the hole of predetermined die length, and the plate without a hole can be carried out in piles, and the plate which formed the part corresponding to a hole in the thin-walled part can also be adopted as a negative.

[0063] The 4th piezo-electricity / electrostriction device 10d shown in drawing 1 (d), it belongs under the category of the piezo-electricity / electrostriction device of the 2nd format concerning this invention. Other configurations are the same although it differs in few parts of the configuration of a base with the 1st piezo-electricity / electrostriction device 10a the 4th piezo-electricity / electrostriction device 10d.

[0064] The 4th piezo-electricity / electrostriction device 10d, as shown in drawing 10 (b), it consists of piezo-electricity / electrostriction components 12a and 12b of a base 15 and a pair. A base 15 Plate-like fixed part 15c which connects the moving part 15a and 15b of a Uichi Hidari pair tabular [ long ], and both the moving part 15a and 15b of each other [ in an end section side ] with a narrow width, It consists of the reinforcement sections 15f and 15g of a Uichi Hidari pair which prolong and contact the front face of fixed part 15c from the end section side upper limb of 15d of plate-like attachment sections which connect both the moving part 15a and 15b of each other [ in an other end side ], and each moving part 15a and 15b.

[0065] The base 15 is constituted identically to a base 11, if the point of providing each reinforcement sections 15f and 15g is removed. Moreover, negative 15A of a base 15 will constitute each moving part 15a and 15b, as shown in drawing 9 (a). As the reinforcement sections [ which are prolonged in the method of outside from the end section side at each flank of right and left of opening 15e of H configuration / 15f and 15g ] configuration part is provided, crookedness processing is carried out along with a two-dot chain line L1 and L2 grade as shown in drawing 9 (b), and shown in drawing 10 (a) The 4th piezo-electricity / electrostriction device 10d is formed by pasting up each piezo-electricity / electrostriction components 12a and 12b on the lateral surface of each moving part 15a and 15b.

[0066] The 4th piezo-electricity / electrostriction device 10d, although the 1st piezo-electricity / electrostriction device 10a does so the same operation effectiveness as abbreviation while having the same function, it has reinforced fixed part 15c by each reinforcement sections 15f and 15g especially. Although it has pasted up on fixed part 15c, as the adhesion means, the adhesion means by adhesives, such as spot welding, sticking by pressure, a caulking, soldering, low attachment, an epoxy resin, and UV hardening mold resin, etc. can be used for each reinforcement sections 15f and 15g. Also among these adhesion means, especially spot welding is desirable.

[0067] The 5th piezo-electricity / electrostriction device 10e shown in drawing 1 (e) belong under the category of the piezo-electricity / electrostriction device of the 2nd format concerning this invention. The 5th piezo-electricity / electrostriction device 10e differs in few parts of the configuration of a base the 4th piezo-electricity / electrostriction device 10d, and other configurations are the same.

[0068] A deer is carried out. The 5th piezo-electricity / electrostriction device 10e As shown in drawing 12 (b), it is what consists of piezo-electricity / electrostriction components 12a and 12b of a base 16 and a pair. A base 16 Plate-like fixed part 16c which connects the moving part 16a and 16b of a Uichi Hidari pair tabular [ long ], and both the moving part 16a and 16b of each other [ in an end section side ] with a narrow width, It consists of the reinforcement sections 16f and 16g crooked in the shape of a flange in the inside sense from 16d of plate-like attachment sections which connect both the moving part 16a and 16b of each other [ in an other end side ], and each edge of each moving part 16a and 16b.

[0069] The base 16 is constituted identically to a base 15, if an each reinforcement sections [ 16f and 16g ]

configuration removes a different point from the configuration which are each reinforcement sections 15f and 15g. Moreover, negative 16A of a base 16 is the thing which will constitute each moving part 16a and 16b and in which each flank of right and left of opening 16e of H configuration is carrying out the predetermined die-length protrusion in order, as shown in drawing 11 (a). As shown in this drawing (b) along with the two-dot chain line L1 shown in drawing 11 (a), and L2 grade, crookedness processing is carried out, and as shown in drawing 12 (a), the 5th piezo-electricity / electrostriction device 10e is formed by pasting up each piezo-electricity / electrostriction components 12a and 12b on the lateral surface of each moving part 16a and 16b.

[0070] In addition, in the 5th piezo-electricity / electrostriction device 10e, although the reinforcement sections 16f and 16g are in the condition of not pasting up, as for fixed part 16c and 16d of attachment sections, it is much more desirable [ the sections ] to paste up on fixed part 16c and 16d of attachment sections. As an adhesion means, means, such as adhesion by adhesives, such as spot welding, sticking by pressure, a caulking, soldering, low attachment, an epoxy resin, and UV hardening mold resin, etc., are employable. Also among these adhesion means, especially spot welding is desirable.

[0071] Although the 5th piezo-electricity / electrostriction device 10e does so the same operation effectiveness as abbreviation while having the same function, as for the 1st piezo-electricity / electrostriction device 10a, it has reinforced fixed part 16c and 16d of attachment sections by each reinforcement sections 16f and 16g especially.

[0072] The 6th piezo-electricity / electrostriction device 10f shown in drawing 1 (f), it belongs under the category of the piezo-electricity / electrostriction device of the 2nd format concerning this invention. Other configurations are the same although it differs from the 1st piezo-electricity / electrostriction device 10a the 6th piezo-electricity / electrostriction device 10f at the point which added the reinforcement member to the base.

[0073] A deer is carried out. The 6th piezo-electricity / electrostriction device 10f As shown in drawing 14 (b), it is what consists of piezo-electricity / electrostriction components 12a and 12b of a base 17 and a pair. A base 17 Plate-like fixed part 17c which connects the moving part 17a and 17b of a Uichi Hidari pair tabular [ long ], and both the moving part 17a and 17b of each other [ in an end section side ] with a narrow width, It consists of 17f of tabular reinforcement members which it was infixed between end section 17d of plate-like attachment sections which connect both the moving part 17a and 17b of each other [ in an other end side ], and each moving part 17a and 17b sides, and were pasted up on the front face of fixed part 17c.

[0074] Negative 17A of a base 17 is the thing of the same configuration as negative 11A of a substrate 11, as shown in drawing 13 (a). As are shown in drawing 13 (b), and crookedness processing is carried out in accordance with two-dot chain lines L1 and L2 and it is shown in drawing 14 (a) The 6th piezo-electricity / electrostriction device 10f is formed by pasting up 17f of reinforcement members on the front face of fixed part 17c between end section both the moving part 17a and 17b sides, and pasting up each piezo-electricity / electrostriction components 12a and 12b on the lateral surface of each moving part 17a and 17b. The 6th piezo-electricity / electrostriction device 10f, while having the function that the 4th piezo-electricity / electrostriction device 10d is the same, the same operation effectiveness as abbreviation is done so.

[0075] The 7th piezo-electricity / electrostriction device 10g shown in drawing 1 (g), it belongs under the category of the piezo-electricity / electrostriction device of the 2nd format concerning this invention. Other configurations are the same although the configuration of the fixed part of a base and the attachment section differs from the 1st piezo-electricity / electrostriction device 10a the 7th piezo-electricity / electrostriction device 10g.

[0076] The 7th piezo-electricity / electrostriction device 10g, as shown in drawing 16 (b), it consists of piezo-electricity / electrostriction components 12a and 12b of a base 18 and a pair. The base 18 consists of plate-like fixed part 18c which connects the moving part 18a and 18b of a Uichi Hidari pair tabular [ long ], and both the moving part 18a and 18b of each other [ in an end section side ] with a narrow width, and 18d of the plate-like attachment sections which connect both the moving part 18a and 18b of each other [ in an other end side ]. Fixed part 18c is carrying out the predetermined die-length protrusion of the predetermined die-length projection from the end section side of both the moving part 18a and 18b, and the 18d of the attachment sections from the other end side of both the moving part 18a and 18b. Therefore, fixed part 18c and 18d of attachment sections are expanded from fixed part 11c and 11d of attachment sections in the base 11 of the 1st piezo-electricity / electrostriction device 10a, and they have secured a big area.

[0077] The base 18 is constituted identically to a base 11, if the point that the area of fixed part 18c and 18d of attachment sections is expanded is removed. Moreover, negative 18A of a base 18 is that in which the part before and behind opening 18e of H configuration which will constitute fixed part 18c and 18d of attachment sections is carrying out the predetermined die-length protrusion in order, as shown in drawing 15 (a). As shown in drawing 15 (b), crookedness processing is carried out in accordance with two-dot chain lines L1 and L2, and as shown in drawing 16



(a), the 7th piezo-electricity / electrostriction device 10g is formed by pasting up each piezo-electricity / electrostriction components 12a and 12b on the lateral surface of each moving part 18a and 18b.

[0078] The 7th piezo-electricity / electrostriction device 10g, although the 1st piezo-electricity / electrostriction device 10a does so the same operation effectiveness as abbreviation while having the same function, especially, it can expand fixed part 18c and 18d of attachment sections, and can aim at expansion of the adhesion area to control-section-ed articles, such as expansion of the adhesion area to the gimbal of a suspension, and the magnetic head of a hard disk drive.

[0079] The 8th piezo-electricity / electrostriction device 20a shown in drawing 1 (h) belong under the category of the piezo-electricity / electrostriction device of the 1st format concerning this invention. As for the 1st piezo-electricity / electrostriction device 10a, the 8th piezo-electricity / electrostriction device 20a differs in the configuration of a base greatly.

[0080] A deer is carried out, as the 8th piezo-electricity / electrostriction device 20a is shown in drawing 18 (b), it consists of piezo-electricity / electrostriction components 22a and 22b of a base 21 and a pair, and the base 21 consists of plate-like fixed part 21c which connects mutually long tabular moving part 21a and 21b and both moving part 21a and 21b of a Uichi Hidari pair by the end section side with a narrow width. However, the attachment section does not possess in the other end side of both the moving part 21a and 21b.

[0081] Negative 21A of the base 21 concerned pierces and processes a plate, and is having 21d of openings of a portal configuration formed as shown in drawing 17 (a). 21d of openings is the thing of the configuration equipped with 3 for 21d 2 and 21d [ of both / these / slots ] other end side between 1 or 21d2 of side slots of the shape of a straight line of the pair prolonged in an order both-ends side in the flank of monotonous right and left 21d of notching \*\*\*\* opening parts. [ 1 or 21d ] In each flank of right and left of negative 21A, in 2, as shown in this drawing (b), along with the center lines L1 and L2 prolonged in the longitudinal direction in the core of the width of face of 2, 21d [ of these slots ] 1 or 21d of 21d [ of each side slot ] 1 or 21d of bases 21 is formed in the right angle by carrying out crookedness processing. While 21d [ of each side slot ] 1 or 21d of side edge parts of 2 is formed in each moving part 21a and 21b by carrying out crookedness processing of each flank of right and left of negative 21A in this way, 21d part between 1 or 21d2 of method slots of both sides is formed in fixed part 21c.

[0082] Thus, as shown in the base 21 constituted by one by negative 21A at drawing 18 (a), piezo-electricity / electrostriction components 22a and 22b are pasted up on the lateral surface of each of those moving part 21a and 21b through adhesives, and the piezo-electricity / electrostriction device 20a shown in this drawing (b) are formed. Although the formed piezo-electricity / electrostriction device 20a are used between the other end sides of both the moving part 21a and 21b where control-section-ed articles, such as the magnetic head, are pasted up, and it functions as the piezo-electricity / electrostriction device of this conventional seed format similarly, since the base 21 is constituted by negative of one sheet 21A in one, it does the operation effectiveness like the following so.

[0083] That is, in the 8th piezo-electricity / electrostriction device 20a, it is the thing of the integral construction which a base 21 becomes from negative 21A, and since it consists of one component part, a component part can reduce the man day with a group of a component part, and can mitigate cost sharply while it becomes a base 21 and two kinds such as piezo-electricity / electrostriction components 22a and 22b and can reduce sharply the component part of piezo-electricity / electrostriction device 20.

[0084] Moreover, in the 8th piezo-electricity / electrostriction device 20a, since there are very few components mark of a component part and there are also in jointing about that of each component parts, the variation in adhesion of each component parts has a nil or device property with a high precision which is not almost and was set up. [ very few ]

[0085] Moreover, in the 8th piezo-electricity / electrostriction device 20a, if it is in the formation, the dust which does not take a means to cut device original recording by many parts, and is generated at the time of cutting of device original recording, and contamination resulting from adhesion of other contaminations are not like the former. For this reason, if a base 21, and the piezo-electricity / electrostriction components 22a and 22b are beforehand washed on the occasion of the assembly of the 8th piezo-electricity / electrostriction device 20, there is almost nothing, and washing of piezo-electricity / electrostriction device 20a can be omitted, or the assembled piezo-electricity / electrostriction device 20a have that there is no contamination or the big advantage that it can finish easily.

[0086] Anchoring of the control-section-ed article to the 8th piezo-electricity / electrostriction device 20a etc. is performed by fixing to the tip side inside 21a1 of both the moving part 21a and 21b, and 21b1 through adhesives. In this case, so that clearly, if drawing 19 which shows the piezo-electricity / electrostriction device 20c which is the modification of the piezo-electricity / the electrostriction device 20a concerned, and which is mentioned later is referred to When the height H1 of device 20a is lower than the height H2 of a control-section-ed article Device 20a and a control-section-ed article the height H3 in assembly \*\*\*\*\* the height H2 of a control-section-ed article -- being the

same ( $H_3=H_2$ ) -- it becomes, the height  $H_1$  of device 20a can be disregarded, and there is an advantage which can carry out space-saving-ization further as compared with the piezo-electricity / electrostriction device of other gestalten of this invention.

[0087] In addition, in the prefabricated frame structure concerned, since it is the structure which sandwiches a control-section-ed article in both the moving part 21a and 21b, it is necessary to set it as a width-of-face dimension and EQC including the thickness of the adhesives layer between which the tip side inside 21a1 in both the moving part 21a and 21b and spacing of 21b1 are made to be placed with the width of face of a control-section-ed article. When this is neglected and the tip side inside 21a1 of both the moving part 21a and 21b and spacing of 21b1 are too narrow Components become impossible [ assembly ], without the ability arranging between the tip side inside 21a1 and 21b1, and contrary to this, when the tip side inside 21a1 of both the moving part 21a and 21b and spacing of 21b1 are too large, a control-section-ed article serves as assembly impossible, without the ability pasting the tip side inside 21a1 and both of 21b1.

[0088] Moreover, though the tip side inside 21a1 of both the moving part 21a and 21b and spacing of 21b1 can be set as the width-of-face dimension which components can arrange and can be pasted up on the tip side inside 21a1 and both of 21b1 when taking the prefabricated frame structure concerned If the thickness of the adhesives layer which pastes up a control-section-ed article on each tip side inside 21a1 and 21b1 varies, it will become the cause which displacement resonance of both the moving part 21a and 21b changes, and dispersion produces in a device property. For this reason, it enables it to create the base 21 which carried out crookedness processing with high precision in large quantities by taking a highly precise press-forming means in crookedness processing at the time of formation of a base 21. Dispersion in the thickness of the adhesives layer which pastes up components on each tip side inside 21a1 and 21b1 is lessened as much as possible by this, and dispersion in a device property is considering as the thing of very small quality.

[0089] The piezo-electricity / electrostriction device 20c which is the 1st modification which transformed the 8th piezo-electricity / electrostriction device 20a are shown in drawing 19 . As for piezo-electricity / electrostriction device 20a, the piezo-electricity / the electrostriction device 20c concerned make a basic configuration the same, and it differs in the configuration with piezo-electricity / electrostriction device 20a only in that the point of moving part 21a and 21b is bent inside. That is, each moving part 21a and 21b has the bending section 21a2 and 21b2 in a point. Each bending section 21a2 and 21b2 are bent about 180 degrees, the point of moving part 21a and 21b is formed in the inside, the bending section 21a2 and the medial surface of 21b2 have countered mutually, and both [ these ] medial surfaces serve as an attachment part of the control-section-ed article H. The control-section-ed article H is pasted up and attached in the bending section 21a2 and the medial surface of 21b2 through proper adhesives.

[0090] In addition, since the configuration of others of the piezo-electricity / the electrostriction device 20c concerned is the same as piezo-electricity / electrostriction device 20a, it attaches the sign same about the same configuration member and the same configuration part, and omits the detailed explanation.

[0091] A deer can be carried out, both the bending section 21a2 and 21b2 can prescribe the adhesion die length and adhesion area to the control-section-ed article H in the piezo-electricity / the electrostriction device 20c concerned, and dispersion in the adhesion die length of the control-section-ed article H between each devices and adhesion area can be canceled effectively. Thereby, dispersion in the value of the displacement resonance of device each resulting from dispersion in the adhesion die length of the control-section-ed article H and adhesion area is cancelable.

[0092] In addition, it sets to the piezo-electricity / the electrostriction device 20c concerned. As the operation effectiveness of the 8th piezo-electricity / electrostriction device 20a has described, since the height  $H_1$  of device 20c is lower than the height  $H_2$  of a control-section-ed article, The height  $H_3$  in the condition of having attached the control-section-ed article H in device 20c the height  $H_2$  of a control-section-ed article -- being the same ( $H_3=H_2$ ) -- it becomes, the height  $H_1$  of a device 20 can be disregarded, and there is an advantage which can carry out space-saving-ization further as compared with the piezo-electricity / electrostriction device of other gestalten of this invention.

[0093] The piezo-electricity / electrostriction device 20d which is the 2nd modification which transformed the 8th piezo-electricity / electrostriction device 20a are shown in drawing 20 . The piezo-electricity / the electrostriction device 20d concerned, a basic configuration is made the same, moving part 21a and 21b is formed in the thin band-like plate with a stage, and piezo-electricity / electrostriction device 20a has become the refraction section 21a3 which the point of moving part 21a and 21b deflected inside more slightly than the subject section, and 21b3. The refraction section 21a3 of moving part 21a and 21b and 21b3 counter mutually, are located, and these refraction sections 21a3 and both the medial surfaces of 21b3 serve as an attachment part of the control-section-ed article H like both the bending section 21a2 in piezo-electricity / electrostriction device 20c, and 21b2. The control-section-ed article H is pasted up and attached in the refraction section 21a3 and the medial surface of 21b3 through proper adhesives. Therefore, the piezo-electricity / the electrostriction device 20d concerned, it functions as piezo-electricity / electrostriction device 20c



similarly, and the same operation effectiveness is done so.

[0094] In addition, since the configuration of others (the piezo-electricity / the electrostriction device 20d concerned) is the same configuration as piezo-electricity / electrostriction device 20c, the same configuration member as piezo-electricity / electrostriction device 20c and the same configuration part attach the same sign as piezo-electricity / electrostriction device 20c, and omit the detailed explanation.

[0095] The 9th piezo-electricity / electrostriction device 20b shown in drawing 1 (i) belong under the category of the piezo-electricity / electrostriction device of the 2nd format concerning this invention. As for the 1st piezo-electricity / electrostriction device 10a, the 9th piezo-electricity / electrostriction device 20b differs in the configuration of a base greatly.

[0096] A deer is carried out. The 9th piezo-electricity / electrostriction device 20b As shown in drawing 22 (b), it is what consists of piezo-electricity / electrostriction components 22a and 22b of a base 23 and a pair. A base 23 It is constituted from plate-like [ which connects fixed part 23c of a narrow width, and both the moving part 23a and 23b of each other / in an other end side / by plate-like / which connects the moving part 23a and 23b of a Uichi Hidari pair tabular / long / and both the moving part 23a and 23b of each other / in an end section side / with a narrow width ] by 23d of attachment sections of a narrow width.

[0097] Negative 23A of the base 23 concerned pierces and processes a plate, and is having opening 23e of an abbreviation square formed as shown in drawing 21 (a). The base 23 is formed by crooking each flank of right and left of negative 23A at a right angle at each opening edge of opening 23e along with the center lines L1 and L2 prolonged in a longitudinal direction along this opening edge, as shown in this drawing (b). While the side edge part of each opening edge is formed in each moving part 23a and 23b by carrying out crookedness processing of each flank of right and left of negative 23A in this way, between the side edge parts of a double door opening edge is formed in fixed part 23c and 23d of attachment sections.

[0098] Thus, as shown in the base 23 constituted from negative 23A by one at drawing 22 (a), piezo-electricity / electrostriction components 22a and 22b are pasted up on the lateral surface of each of those moving part 23a and 23b through adhesives, and the piezo-electricity / electrostriction device 20b shown in this drawing (b) are formed. Although the assembled piezo-electricity / electrostriction device 20b function as the piezo-electricity / electrostriction device of this conventional seed format similarly, since the base 23 is constituted by negative of one sheet 23A in one, it does so the same operation effectiveness as the 1st piezo-electricity / electrostriction device 10a and the 8th piezo-electricity / electrostriction device 20a, and abbreviation.

[0099] Although fixed part 23c and 23d of attachment sections of the 9th piezo-electricity / the electrostriction device 20b concerned are small and the adhesion area to an actuator or a control-section-ed article is small, when the means which can join components firmly in a small adhesion area like spot welding, for example can be taken, a large fixed part and the attachment section will act as excessive \*\*\*\* (mass). The 9th piezo-electricity / the electrostriction device 20b concerned are different at this point in other piezo-electricity / electrostriction devices 10a-10g, can set up a part and resonance frequency without excessive mass highly, and has the advantage which can accelerate actuation of an actuator.

[0100] In the piezo-electricity / electrostriction devices 10a-10g concerning each above-mentioned operation gestalt, and 20a-20d Although each openings 11e-18e, and 21d and 23e are pierced and formed in coincidence at the time of blanking processing in each bases 11-18 and the punching structure adopted as a negative which forms 21 and 23 About each openings 11e-18e of these negatives, and 21d and 23e, the negative pierced by the predetermined configuration is pierced and it can form with perforating process means, such as means other than a means, for example, laser beam machining, an electron discharge method, drilling, ultrasonic machining, and etching. In these perforating process means, although weld flash may occur in a hole processing end face, weld flash is easily removable by etching processing or blasting processing with means other than etching.

[0101] Moreover, a folding include angle has the desirable thing of each piezo-electricity / electrostriction devices 10a-10g, bases (20a-20d) 11, 13-18, moving-part 11a that constitutes 21 and 23, and 11b-- it is supposed to fixed part 11c-- and 11d [ of attachment sections ]-- that it is almost perpendicular, and a crossover include angle is more preferably made into 90\*\*1 time 90\*\*5 times 90\*\*10 degrees. Moving part 11a and 11b -- If a folding include angle shifts from 90 degrees, the variation rate of the influence direction will become large. In addition, above-mentioned sign -- means having omitted other corresponding signs of a part, and it is using it in order to make a publication simple.

[0102] About the bases 11-18 which crookedness processing was carried out and were formed, and 21 and 23, it is desirable to give ultrasonic cleaning which uses a detergent, an organic solvent, etc. In ultrasonic cleaning, since a base does not break even if it strengthens power, dirt is easily removable with strong ultrasonic cleaning of power.

[0103] Moreover, although a base, and piezo-electricity / electrostriction component are formed in an exception object,

respectively and each piezo-electricity / electrostriction component are constituted from each piezo-electricity / electrostriction devices 10a-10g, and 20a-20d by pasting the moving part of a base. The part which serves as moving part of the negative before forming in a base in the piezo-electricity / electrostriction device concerning this invention, Or piezo-electricity / electrostriction component can be directly formed in the moving part of a base at a base by forming membranes with means, such as a sputter, and CVD, MBE, or forming piezo-electricity / electrostriction layer, and an electrode with a sol gel process.

[0104] The piezo-electricity / electrostriction devices 10a-10g concerning each above-mentioned operation gestalt, and the piezo-electricity / electrostriction components 12a, 12b, 22a, and 22b which constitute 20a-20d are equipped with the electrode of the pair for impressing electric field to piezo-electricity / electrostriction layer, and this, and are piezo-electricity / electrostriction components, such as a uni-morph mold and a bimorph mold. Especially, the piezo-electricity / electrostriction component of a uni-morph mold are excellent in the stability of the variation rate to derive, and since it is advantageous for lightweight-izing, it is suitable as a component part of piezo-electricity / electrostriction device.

[0105] The piezo-electricity / electrostriction components 31-34 of several examples which are adopted as drawing 23 and drawing 24 suitable for piezo-electricity / electrostriction devices 10a-10g, and the piezo-electricity / electrostriction components 12a, 12b, 22a, and 22b that constitute 20a-20d are shown.

[0106] The piezo-electricity / electrostriction component 31 shown in drawing 23 (a) are the things of 1 layer structure one piezo-electricity / electrostriction layer are [ layer structure ], and consists of the 1st and 2nd electrode 31b and 31c of piezo-electricity / electrostriction layer 31a, and a vertical pair, and terminals 31d and 31e of a pair. The piezo-electricity / electrostriction component 32 shown in this drawing (b) are the things of the two-layer structure where piezo-electricity / electrostriction layer is two-layer, and consists of piezo-electricity / electrostriction layers 32a and 32b, both piezo-electricity / electrostriction layer 32a, 1st electrode 32c that intervenes among 32b, 32d of the 2nd electrode which surrounds the lateral surface of both piezo-electricity / electrostriction layers 32a and 32b, and terminals 32e and 32f of a pair.

[0107] Moreover, the piezo-electricity / electrostriction components 33 and 34 which are shown in drawing 24 are the things of 4 layer structures four piezo-electricity / electrostriction layers are [ layer structures ]. The piezo-electricity / electrostriction component 33 shown in this drawing (a) consist of the 1st and 2nd electrode 33e and 33f which intervenes between piezo-electricity / electrostriction layers 33a, 33b, 33c, and 33d, and these both piezo-electricity / electrostriction layers, and is surrounded, and terminals 33g and 33h of a pair. Moreover, it consists of the 1st and 2nd electrode 34e and 34f which piezo-electricity / electrostriction component 33 differs in the arrangement part of a terminal, and the piezo-electricity / electrostriction component 34 shown in this drawing (b) intervene between piezo-electricity / electrostriction layers 34a, 34b, 34c, and 34d, and these both piezo-electricity / electrostriction layers, and is surrounded, and terminals 34g and 34h of a pair.

[0108] Each these piezo-electricity / electrostriction components 31-34 are suitably adopted according to the application of piezo-electricity / electrostriction device as the piezo-electricity / electrostriction components 12a, 12b, 22a, and 22b of each piezo-electricity / electrostriction device.

[0109] Although electrostrictive ceramics is used for the piezo-electricity / electrostriction layer which constitutes each piezo-electricity / electrostriction components 31-34, it is also possible to use the electrostriction ceramics, strong dielectric ceramics, the antiferroelectric ceramics, etc. However, when using piezo-electricity / electrostriction device for magnetic-head positioning of a hard disk drive etc., since linearity with the amount of displacement of the attachment section, driver voltage, or output voltage is important, it is desirable to use the small ingredient of distortion hysteresis. It is desirable that a coercive electric field uses an ingredient 10kV [ /mm ] or less.

[0110] Specifically as an ingredient for forming piezo-electricity / electrostriction layer, independence, such as lead zirconate, lead titanate, magnesium niobic acid lead, zinc niobic acid lead, manganese niobic acid lead, antimony stannic-acid lead, a manganese lead wolframate, cobalt niobic acid lead, barium titanate, a titanic-acid sodium bismuth, niobic acid potassium sodium, and a tantalic acid strontium bismuth, or such proper mixture can be mentioned. The ingredient which uses lead zirconate, lead titanate, and magnesium niobic acid lead as a principal component especially, or the ingredient which uses a titanic-acid sodium bismuth as a principal component is suitable.

[0111] A proper ingredient can be added into the ingredient for forming piezo-electricity / electrostriction layer, and the property of piezo-electricity / electrostriction layer can be adjusted to it. As add-in material, the independence of oxides, such as a lanthanum, calcium, strontium, molybdenum, a tungsten, barium, niobium, zinc, nickel, manganese, caesium, cadmium, chromium, cobalt, antimony, iron, an yttrium, a tantalum, a lithium, a bismuth, and tin, or the ingredient which finally serves as an oxide, or such proper mixture can be mentioned.

[0112] For example, there is an advantage which can adjust a coercive electric field and a piezo-electric property by

making the lead zirconate which is a principal component, lead titanate, magnesium niobic acid lead, etc. contain a lanthanum and strontium. In addition, addition of ingredients which are easy to vitrify, such as a silica, should be avoided. It is because ingredients which are easy to vitrify, such as a silica, tend to react with piezo-electricity / electrostriction layer at the time of heat treatment of piezo-electricity / electrostriction layer, the presentation is changed and a piezo-electric property is degraded.

[0113] The electrode which constitutes each piezo-electricity / electrostriction components 31-34 is a solid-state at a room temperature, and it is desirable to be formed with the metallic material excellent in conductivity. As a metallic material, the simple substance of metals, such as aluminum, titanium, chromium, iron, cobalt, nickel, copper, zinc, niobium, molybdenum, a ruthenium, palladium, a rhodium, silver, tin, a tantalum, a tungsten, iridium, platinum, gold, and lead, or the alloy of these metals can be mentioned. Moreover, the cermet ingredient which makes these metallic materials come to distribute the ceramics of the same ingredient as piezo-electricity / electrostriction layer or a different ingredient can also be used.

[0114] Each piezo-electricity / electrostriction components 31-34 are in the condition which carried out the laminating of piezo-electricity / electrostriction layer, and each electrode of each other, and it is desirable to form by calcinating in one. In this case, it is desirable to adopt as an electrode what consists of refractory metal ingredients, such as platinum, palladium, or these alloys, and the electrode which consists of a cermet ingredient which is the mixture of a refractory metal ingredient, and the formation ingredient of piezo-electricity / electrostriction layer and other ceramic ingredients. As for the thickness of an electrode, it is desirable to have the shape of a thin thin film as much as possible from becoming the factor which affects the variation rate of piezo-electricity / electrostriction component. For this reason, in order for the electrode which is calcinated by piezo-electricity / electrostriction layer, and one, and is formed in them to serve as the shape of a thin thin film as much as possible, as for the ingredient which forms an electrode, it is desirable to use it with the gestalt of a metal paste, for example, a golden resinate paste, a platinum resinate paste, a silver resinate paste, etc.

[0115] The thickness of each piezo-electricity / electrostriction components 31-34 has the desirable range of 40 micrometers - 180 micrometers, when using it as the piezo-electricity / electrostriction components 12a, 12b, 22a, and 22b of the piezo-electricity / electrostriction device of each operation gestalt. The miniaturization of a device becomes difficult when it is easy to damage during handling when thickness is less than 40 micrometers, and thickness exceeds 180 micrometers. Moreover, like piezo-electricity / electrostriction components 33 and 34, by considering as multilayer structure, piezo-electricity / electrostriction component makes the output increase, and can aim at expansion of the variation rate of a device. Moreover, since the rigidity of a device improves by making piezo-electricity / electrostriction component into multilayer structure, the resonance frequency of a device becomes high and there is an advantage which can accelerate displacement actuation of a device.

[0116] Each piezo-electricity / electrostriction components 31-34 are created with the means which cuts down many negatives of the large area which carries out the laminating of piezo-electricity / electrostriction layer, and the electrode by printing or tape forming, and comes to calcinate them in a predetermined dimension by the dicer, the slicer, a wire saw, etc. Since it is thin and the degree of hardness is low as compared with a well-known ceramic base, piezo-electricity / electrostriction components 31-34 can set up the cutting speed of a negative quickly, and can carry out processing processing in large quantities at high speed.

[0117] Each piezo-electricity / electrostriction components 31-34 are simple platy structures, and easily [ handling ], since surface area is small, there is little coating weight of dirt and they tend to remove dirt. However, since piezo-electricity / electrostriction component makes a ceramic ingredient a subject, it needs to set up suitable washing conditions in ultrasonic cleaning. In the piezo-electricity / electrostriction component started from the negative, after carrying out precision washing by US washing, it is desirable among atmospheric air to remove completely the moisture which has entered into the detailed pore of a ceramic ingredient, and the organic substance by heat-treating at 100 degrees C - 1000 degrees C.

[0118] As the piezo-electricity / electrostriction devices 10a-10g concerning each operation gestalt, and the piezo-electricity / electrostriction components 12a, 12b, 22a, and 22b which constitute 20a-20d When adopting each piezo-electricity / electrostriction components 31-34, as an adhesion means against the base of each piezo-electricity / electrostriction components 31-34 It is desirable to use the adhesives of inorganic systems, such as resin system adhesives, such as an epoxy resin, UV resin, and hot melt adhesive, and glass, cement, solder, low material, and it can also use what mixed metal powder and ceramic powder in resin system adhesives. As for the degree of hardness of adhesives, 80 or more are desirable at Shore D.

[0119] In addition, in the part of the front face which the piezo-electricity / electrostriction component in a base paste up, it is desirable to perform split-face processing of blasting, etching, plating, etc. beforehand. By making surface

roughness like jointing into about  $Ra=0.1$  micrometer-5micrometer, adhesion area can be extended and bond strength can be raised. In this case, the one where the front face like jointing by the side of piezo-electricity / electrostriction component is also coarser is desirable. It is made not to arrange an electrode on the front face of the piezo-electricity / electrostriction layer of the lowest layer to flow through an electrode with a base.

[0120] In using solder and low material, in order to improve wettability as adhesives, it is desirable to arrange the electrode layer of a metallic material on the front face of piezo-electricity / electrostriction component. As for the thickness of adhesives, it is desirable that it is the range of 1 micrometer - 50 micrometers. Although the thinner one of the thickness of adhesives is desirable in respect of the point of reducing the variation rate of a device, and dispersion of the resonance characteristic, and space-saving-izing, in order to secure properties, such as bond strength, a variation rate, and resonance, the optimal thickness is set up for every adhesives to adopt.

[0121] In case piezo-electricity / electrostriction component is pasted up on a base, as the electrode of piezo-electricity / electrostriction component becomes the fixed part side of a base, it pastes up so that piezo-electricity / electrostriction component may start the crookedness location of a fixed part completely. Although it is desirable to make it in agreement with the edge by the side of the fixed part of a base, and to paste up, in order to make easy connection between the terminal of piezo-electricity / electrostriction component, and an external terminal, piezo-electricity / electrostriction component may make piezo-electricity / electrostriction component project from the edge of a base to the method of outside, and may be pasted up. However, since it is easy to damage as compared with the base which is metal, piezo-electricity / electrostriction component needs cautions for handling.

[0122] Drawing 25 shows the example which adopted piezo-electricity / electrostriction component 34 as each piezo-electricity / electrostriction components 12a and 12b in the 1st piezo-electricity / electrostriction device 10a which belongs under the category of the piezo-electricity / electrostriction device of the 2nd format concerning this invention. Below, the configuration of the piezo-electricity / electrostriction device concerning this invention, actuation, the operation effectiveness, etc. are explained to a detail based on the 1st piezo-electricity / the electrostriction device 10a concerned as an example of representation which has the basic configuration of the piezo-electricity / electrostriction device applied to this invention in the 1st piezo-electricity / electrostriction device 10a of the operation gestalt concerned.

[0123] In the piezo-electricity / the electrostriction device 10a concerned, when a part of piezo-electricity / electrostriction component 34 are located in fixed part 11c of a base 11, as shown in drawing 26 The minimum distance between the boundary sections of the 11d [ of attachment sections ] boundary section and fixed part 11c in the moving part 11a and 11b of a pair is set to  $L_a$ . When setting distance of the shorter one from a boundary part with 11d of attachment sections, and moving part 12a and 12b to each electrodes [ of piezo-electricity / electrostriction component 34 / 34e and 34f ] one of edges to  $L_b$ , it is desirable that  $(1-L_b/L_a)$  is 0.4 or more, and they are 0.5-0.8 much more preferably. When this value is less than 0.4, the large variation rate of a device cannot be taken. When this value is 0.5-0.8, it is easy to attain the variation rate of a device, and coexistence of resonance. In this case, the configuration which pastes up piezo-electricity / electrostriction component 34 can also be taken only to one side of moving part 12a and 12b, and a more desirable operation gestalt can be told to it. In addition, it is also the same as when located in the part a part of whose piezo-electricity / electrostriction component 34 are 11d of attachment sections.

[0124] In the piezo-electricity / the electrostriction device 10a concerned, impression of an each electrodes [ of both piezo-electricity / electrostriction component 34 / 34e and 34f ] electrical potential difference is performed through each terminals 34g and 34h. 34g of terminals [ as opposed to one electrode 34e in an each terminals / 34g and 34h / location ] is formed in the back twist of fixed part 11c, and 34h of terminals to 34h of electrodes of another side is formed in the wall twist of fixed part 11c. One of the terminals 34g and 34h can be made to be able to share with the ground of a base 11 between making it flow with a base 11, and can be omitted by it. Even if the width of face of the piezo-electricity / electrostriction component 34 to paste up does not need to be the same as the width of face of jointing of a base 11 (about jointing of moving part 11a and 11b) and it differs, it is satisfactory in any way on the function of a device.

[0125] The piezo-electricity / the electrostriction device 10a concerned are formed by SUS304 of 40 micrometers of board thickness in a base 11, and is formed in the overall length of 1.9mm, and magnitude with a full of 1.5mm. The piezo-electricity / electrostriction component 34 adopted as piezo-electricity / electrostriction components 12a and 12b are the four-layer structures which used PZT, and the piezo-electricity / electrostriction layers [ 34a-34d ] thickness of one layer is 15 micrometers and the thin film with which 3-micrometer platinum and each terminals 34g and 34h consist of a golden paste in each electrodes 34e and 34f. Each piezo-electricity / electrostriction component 34 are pasted up on the lateral surface of each moving part 11a and 11b with the heat-curing epoxy resin adhesive of 1 liquid.

[0126] In the piezo-electricity / the electrostriction device 10a concerned constituted in such magnitude, when the variation rate of 11d of attachment sections at the time of making piezo-electricity / electrostriction component 34 drive

by the 1kHz sine wave of driver voltage  $20 \times 20V$  was measured, it was  $1.5$  micrometers. Moreover, it was 45kHz when the resonance frequency which carries out the sweep of the frequency as sinusoidal-voltage  $0.5V$ , and shows the maximum of a variation rate was measured.

[0127] Next, actuation of the piezo-electricity / electrostriction device concerning this invention is explained based on the above-mentioned 1st piezo-electricity / electrostriction device 10a.

[0128] the condition which shows the piezo-electricity / the electrostriction device 10a concerned in drawing 26 at the time of un-operating [ the electrical potential difference is not impressed to each piezo-electricity / electrostriction components 12a and 12b (34) to operate ] -- it is -- the major axis m of piezo-electricity / electrostriction device 10a (major axis of fixed part 11c), and the medial axis n of 11d of attachment sections -- about -- I am doing one. As it is in this condition, for example, is shown in the wave form chart of drawing 27 (a), electrode 34e of the pair in one piezo-electricity / electrostriction component 12b and the sine wave Wb which has the predetermined bias potential Vb in 34f are applied, and as shown in this drawing (b), the sine wave Wa from which a phase differs about about 180 degrees is applied to the electrodes 34e and 34f of the pair in the piezo-electricity / electrostriction component 12a of another side in said sine wave Wb.

[0129] A deer is carried out and the piezo-electricity / electrostriction layers 34a-34d in one piezo-electricity / electrostriction component 12b carry out contraction displacement in the direction of a principal plane in the phase where the electrical potential difference of maximum was impressed, as opposed to the electrodes 34e and 34f of the pair in one piezo-electricity / electrostriction component 12b.

[0130] Since the stress which makes it bend rightward [ illustration ] (the direction of arrow-head A) to one moving-part 11b occurs in the piezo-electricity / the electrostriction device 10a concerned by this as shown, for example in drawing 28, moving-part 11b bends in this direction. In this case, since the electrodes 34e and 34f of the pair in the piezo-electricity / electrostriction component 12a of another side will be in the condition that an electrical potential difference is not impressed, moving-part 11a of another side follows bending of one moving-part 11b, and bends in moving-part 11b and this direction. Consequently, both the moving part 11a and 11b displaces rightward [ illustration ] to the major axis m of piezo-electricity / electrostriction device 10a. The amount of displacement of this variation rate changes according to the maximum of applied voltage to each piezo-electricity / electrostriction components 12a and 12b. The amount of displacement becomes large, so that the maximum of an electrical potential difference becomes large.

[0131] When the piezo-electricity / electrostriction ingredient which has a high coercive electric field as a layers [ which constitute piezo-electricity / electrostriction component 34 especially / the piezo-electricity / electrostriction layers 34a-34d ] component are adopted, you may make it adjust said bias potential so that the level of the minimum value may turn into negative level slightly as shown in the wave of the two-dot chain line of drawing 27 (a) and (b). In this case, the stress of the bending direction of one moving-part 11b and this direction occurs in moving-part 11a of another side, and the piezo-electricity's / electrostriction component's to which the bias potential's of negative level is impressed, for example, another side's, drive of piezo-electricity / electrostriction component 12a enables it to enlarge more the amount of displacement which is 11d of attachment sections. The piezo-electricity / electrostriction components 12a and 12b to which the bias potential of negative level is impressed can give the function to support the piezo-electricity / electrostriction components 12b and 12a which serve as a subject of displacement actuation, by using the wave shown according to the thing two-dot chain line in drawing 27 (a) and (b), if it puts in another way.

[0132] Thus, in the piezo-electricity / the electrostriction device 10a concerned, since a variation rate with minute piezo-electricity / electrostriction components 12a and 12b will be amplified by big displacement actuation using bending of both the moving part 11a and 11b and will be transmitted to both the moving part 11a and 11b, 11d of attachment sections becomes possible [ carrying out a variation rate greatly to the major axis m of piezo-electricity / electrostriction device 10a ].

[0133] In the piezo-electricity / the electrostriction device 10a concerned, in order to demonstrate the function much more certainly, considering as following is desirable. That is, in order to make displacement actuation of 11d of attachment sections into a positive thing, it is desirable to make or more [ of thickness b of moving part 11a and 11b ] into  $1/2$  distance Ld which requires the substantial drive parts Lc of piezo-electricity / electrostriction components 12a and 12b for fixed part 11c or 11d of attachment sections. moreover, the ratio of the distance c between the walls of moving part 11a and 11b (distance of X shaft orientations), and the width of face d of moving part 11a and 11b (distance of Y shaft orientations) -- it constitutes so that c/d may be set to 0.5-20. the ratio concerned -- c/d is 1-15 preferably and is 1-10 still more preferably. the ratio concerned -- the default value of c/d -- the variation rate of 11d of attachment sections -- it is the convention based on having enlarged the amount and having carried out learning of the ability obtaining the variation rate in an X-axis-Z axial plane dominantly.

[0134] a ratio with the distance c between substantial movable die-length e (distance of Z shaft orientations) in the

moving part 11a and 11b of an overall length  $e_0$ , and the wall of moving part 11a and 11b --  $e/c$  is 0.5-10 preferably and is 0.5-5 still more preferably. The short thing of the die length  $f_1$  (distance of Z shaft orientations) of the connection section with 11d of attachment sections and moving part 11a and 11b and the die length  $f_2$  (distance of Z shaft orientations) of the connection section of fixed part 11c and moving part 11a and 11b is desirable. By shortening 11d of attachment sections, lightweight-izing of a device and increase of resonance frequency can be aimed at. However, in order to secure the rigidity of X shaft orientations of 11d of attachment sections and to make the variation rate into a positive thing, it is desirable to make preferably the ratio  $f_1$  with thickness  $b$  of moving part 11a and 11b /  $f_2$  [  $b$  and  $] / b$  or more into five two or more. Moreover, distance  $e_{ly}$  to distance  $e_{lx}$  and fixed part L1 to 11c or 11d of attachment sections from the crookedness location L1 of a base 11 to moving-part 12a is  $>(e_{lx}/b)$  1 and  $>(e_{ly}/b)$  1, and it is desirable that it is two or more, respectively.

[0135] As for the actual size like each part of the piezo-electricity / the electrostriction device 10a concerned, it is important to set up the adhesion area of 11d of attachment sections for attaching components and fixed part 11c in consideration of the reinforcement of the whole adhesion area for anchoring and a whole device, such as adhesion area for attaching in other members and a terminal for electrodes, endurance, the required amount of displacement and resonance nature, driver voltage, etc.

[0136] Specifically, 100 micrometers - 2000 micrometers of distance  $c$  between the walls of moving part 11a and 11b are 200 micrometers - 1600 micrometers still more preferably preferably. 50 micrometers - 2000 micrometers of width of face  $d$  of moving part 11a and 11b are 100 micrometers - 500 micrometers still more preferably preferably. thickness  $b$  of moving part 11a and 11b -- the variation rate to Y shaft orientations -- the influence which is a component -- relation with the width of face  $d$  of moving part 11a and 11b is  $d > b$ , and is 10 micrometers - 80 micrometers still more preferably 2 micrometers - 300 micrometers preferably so that a variation rate can control effectively.

[0137] 200 micrometers - 3000 micrometers substantial movable die-length  $e$  in moving part 11a and 11b is 300 micrometers - 2000 micrometers still more preferably preferably. The connection die length  $f_1$  with 11d of attachment sections and moving part 11a and 11b and 50 micrometers - the 2000 micrometers of the connection die length  $f_2$  of fixed part 11c and moving part 11a and 11b are 100 micrometers - 1000 micrometers still more preferably preferably.

[0138] distance  $e_{lx}$  from the crookedness location L1 of a base 11 to moving-part 12a -- desirable -- 1 micrometer - 300 micrometers and a pan -- desirable -- 5micrometer- it is 80 micrometers. Moreover, 1 micrometer - 1000 micrometers distance  $e_{ly}$  from the crookedness location L1 of a base 11 to fixed part 11c or 11d of attachment sections is 5 micrometers - 500 micrometers preferably. In addition, the distance (distance corresponding to distance  $e_{ly}$ ) from the distance (distance corresponding to distance  $e_{lx}$ ) from the crookedness location L2 of a base 11 to moving-part 12a and the crookedness location L2 of a base 11 to fixed part 11c or 11d of attachment sections is the same as that of distance  $e_{lx}$  and distance  $e_{ly}$ .

[0139] The outstanding effectiveness that a drive by the low battery is possible and the variation rate of Y shaft orientations over the variation rate of X shaft orientations can be controlled to 5% or less is done so by setting up suitably the variation rate of Y shaft orientations [ as opposed to the variation rate of X shaft orientations by constituting the piezo-electricity / the electrostriction device 10a concerned in this way ] within the limits of the above-mentioned dimension ratio and an actual size, although it can avoid exceeding 10%. If it puts in another way, 11d of attachment sections will be substantially displaced to 1 of X shaft orientations shaft orientations, they are excellent in high-speed responsibility, and have the outstanding property that a big variation rate is obtained by the low battery.

[0140] Moreover, in the piezo-electricity / the electrostriction device 10a concerned, since the base 11 which is the main configuration member is presenting the characteristic configuration, moving part 11a and 11b is in a rectangular condition mostly to fixed part 11c and 11d of attachment sections and it functions like a rib, the rigidity of Y shaft orientations of a device can be set up highly. For this reason, in the piezo-electricity / the electrostriction device 10a concerned, actuation of 11d of attachment sections can be alternatively generated only in a flat surface (inside of an X-axis-Z axial plane), and actuation in the Y-axis-Z axial plane of 11d of attachment sections and actuation of the so-called influence direction can be controlled.

[0141] In addition, in the device concerning this invention, it is also possible by devising the configurations of the fixed part of a base, and the attachment section to unify the gimbal of the suspension of a hard disk drive and the base of a device.

[0142] In addition, two modifications of the 1st piezo-electricity / electrostriction device 10a are shown in drawing 29 and drawing 30 . Fundamentally, although the piezo-electricity / electrostriction device ten a1 concerning both these modifications, and ten a2 are the same configurations as the 1st piezo-electricity / electrostriction device 10a In piezo-electricity / electrostriction device ten a1 fixed part 11c of a base 11 and attachment section 11d mostly in the center section the hollow section 11c1 of a circle configuration and 11d1 form in press forming -- having -- \*\*\*\* -- moreover,



piezo-electricity / electrostriction device ten a2 -- setting -- fixed part 11c of a base 11, and 11d of attachment sections -- mostly, the through hole 11c2 of a circle configuration and 11d2 pierce in the center section, and it is formed in it by processing.

[0143] In piezo-electricity / electrostriction device ten a1, the hollow section 11c1 prepared in fixed part 11c of a base 11 and 11d of attachment sections and 11d1 It is what functions that the adhesives for pasting up the components attached in fixed part 11c and 11d of attachment sections should be held. While being able to make the bond strength to components increase with the hollow section 11c1 and the adhesives held in 1 11d, the flash from the cohesive site of adhesives can be prevented.

[0144] Moreover, in piezo-electricity / electrostriction device ten a2, by 11d, 2 can function as positioning criteria in the case of the assembly (adhesion) of a fixed part 11c and 11d [ of attachment sections ] component, can raise [ the through hole 11c2 prepared in fixed part 11c of a base 11, and 11d of attachment sections, and ] the assembly precision in a back process, and the yield of a product can be raised.

[0145] The 10th piezo-electricity / electrostriction device 20e shown in drawing 1 (j) and (k), and the 11th piezo-electricity / electrostriction device 20f are the piezo-electricity / electrostriction device which belongs under the category of the piezo-electricity / electrostriction device of the 3rd format concerning this invention. Each these piezo-electricity / electrostriction devices 20e and 20f The fixed part which connects the moving part of a right-and-left pair, and both [ these ] moving part of each other [ in an end section side ] as shown in drawing 31 and drawing 32 , The base which has the attachment section which connected both [ these ] moving part of each other [ in an other end side ], and has been separated mutually [ said fixed part ], and the attachment section and the connection section which surrounds the attachment section, each moving part, and a fixed part by one, It considers as a basic configuration providing the piezo-electricity / electrostriction component arranged in one [ at least ] side face of both the moving part of this base, and the piezo-electricity / electrostriction device of each of other operation gestalt differ in the configuration of a base greatly.

[0146] The base 24 which constitutes the 10th piezo-electricity / electrostriction device 20e shown in drawing 31 possesses connection section 24e of fixed part 24c which connects the moving part 24a and 24b of a right-and-left pair, and both the moving part 24a and 24b of each other [ in an end section side ], 24d of attachment sections which connect both the moving part 24a and 24b of each other [ in an other end side ], 24d of attachment sections, and one.

[0147] The base 24 concerned is the thing of the configuration by which the connection section is added to the base 18 which constitutes the 7th piezo-electricity / electrostriction device 10g, connection section 24e of a base 24 is presenting plate-like [ which has 1 24f of rectangular openings in the center section ], and moving part 24a and 24b, fixed part 24c, and 24d of attachment sections are located in the state of one in 24f 1 of openings. In the connection section 24e concerned, the main configuration part of a base 24 is surrounded and the edges-on-both-sides section 24e1 of connection section 24e and 24e2 have the spring function.

[0148] As shown in drawing 32 (a), negative 24A of a base 24 24f of openings of the shape of a rectangle which will constitute connection section 24e 1, It has 2 24f of openings of the shape of a portal which will constitute moving part 24a and 24b, fixed part 24c, and 24d of attachment sections in one, and the base 24 shown in this drawing (b) is formed by carrying out crookedness processing in accordance with the two-dot chain lines L1 and L2 shown in this drawing (a). Thus, the 10th piezo-electricity / electrostriction device 20e shown in drawing 31 are formed in the formed base 24 by pasting up each piezo-electricity / electrostriction components 22a and 22b on the lateral surface of each moving part 24a and 24b.

[0149] The 7th piezo-electricity / electrostriction device 10g, since the 10th piezo-electricity / the electrostriction device 20e concerned possess in one connection section 24e which has a spring function especially although it does so the same operation effectiveness as abbreviation while having the same function, it can operate the connection section 24e concerned as a gimbal of the suspension which constitutes a hard disk drive. If it puts in another way, the base 24 concerned has the function of a gimbal collectively.

[0150] The base 25 which constitutes the 11th piezo-electricity / electrostriction device 20f shown in drawing 33 possesses connection section 25e of fixed part 25c which connects the moving part 25a and 25b of a right-and-left pair, and both the moving part 25a and 25b of each other [ in an end section side ], 25d of attachment sections which connect both the moving part 25a and 25b of each other [ in an other end side ], 25d of attachment sections, and one.

[0151] The base 25 concerned is the thing of the configuration by which the connection section is added to the base 18 which constitutes the 7th piezo-electricity / electrostriction device 10g. Connection section 25e of a base 25 While having 1 25f of portal-like openings in the center section, plate-like [ which has 2 25f of openings of the shape of a rectangle by which the end side was opened wide at the point side ] is presented, and moving part 25a and 25b, fixed part 25c, and 25d of attachment sections are located in the state of one in 25f 2 of openings. In the connection section 25e concerned, the main configuration part of a base 25 is surrounded and the edges-on-both-sides section 25e1 of the

outside of connection section 25e, 25e2 and the inside edges-on-both-sides section 25e3, and 25e4 have the spring function.

[0152] As shown in drawing 34 (a), negative 25A of a base 25 25f of 25f openings of the shape of 1 and a rectangle of openings of the shape of a portal which will constitute connection section 25e 2, It has 3 25f of openings of the shape of a portal which will constitute moving part 25a and 25b, fixed part 25c, and 25d of attachment sections in one, and the base 25 shown in this drawing (b) is formed by carrying out crookedness processing in accordance with the two-dot chain lines L1 and L2 shown in this drawing (a). Thus, the 11th piezo-electricity / electrostriction device 20f shown in drawing 33 are formed in the formed base 25 by pasting up each piezo-electricity / electrostriction components 22a and 22b on the lateral surface of each moving part 25a and 25b.

[0153] The 11th piezo-electricity / the electrostriction device 20f concerned, since connection section 25e which has a spring function especially is provided in one although the same operation effectiveness as abbreviation is done so while having the function that the 7th piezo-electricity / electrostriction device 10g is the same, the connection section 25e concerned can be operated as a gimbal of the suspension which constitutes a hard disk drive. If it puts in another way, the base 25 concerned has the function of a gimbal collectively. Moreover, in the 11 piezo-electricity / the electrostriction device 20f concerned, since it has a higher spring function as compared with the 10th piezo-electricity / electrostriction device 20e, the function of a gimbal can be demonstrated more exactly.

[0154] Drawing 35 shows the hard disk drive 40 which carried the 10th piezo-electricity / electrostriction device 20e which is the piezo-electricity / electrostriction device of the 3rd format concerning this invention. The hard disk drive 40 concerned is the well-known thing equipped with the suspension, on the base 41, it has the voice coil 42 and the magnet 43, and the suspension 45 which carried the 10th piezo-electricity / electrostriction device 20e in the arm 44 prepared on the base 41 is attached. In addition, a sign 46 shows a magnetic disk.

[0155] A deer is carried out, the magnetic head 47 (slider) is fixed through adhesives on fixed part 24c of a base 24, and the 10th piezo-electricity / the electrostriction device 20e concerned are being fixed to the rear-face side of a suspension 45 with means, such as spot welding, in the rear-face side by the side of 24d of attachment sections in connection section 24e of a base 24, as shown in drawing 36 . With such attachment structure of the 10th piezo-electricity / the electrostriction device 20e concerned, connection section 24e of a base 24 has the function of the conventional gimbal, and there is an advantage which can omit use of the conventional gimbal in loading to the suspension 45 of the 10th piezo-electricity / the electrostriction device 20e concerned.

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[Translation done.]



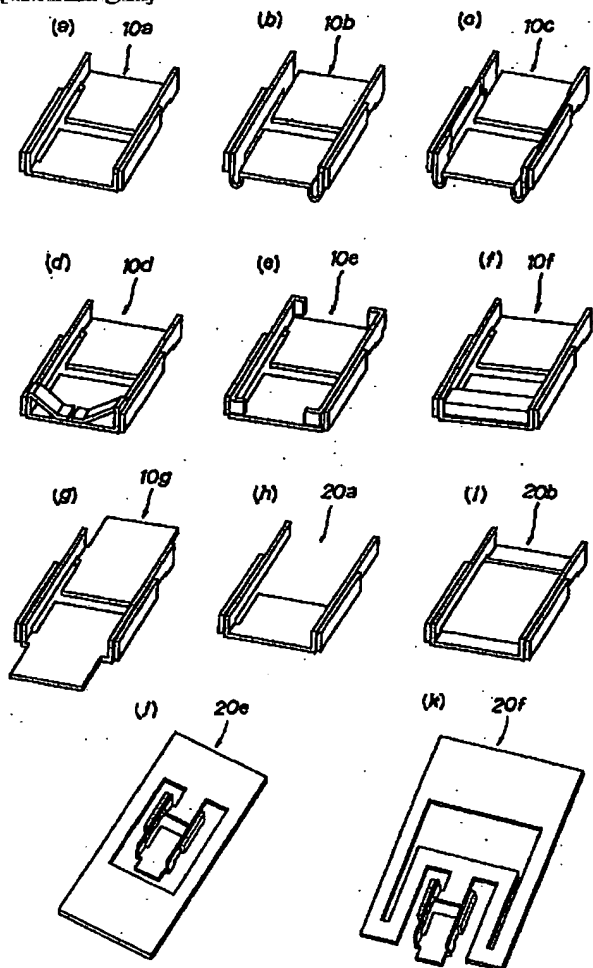
## \* NOTICES \*

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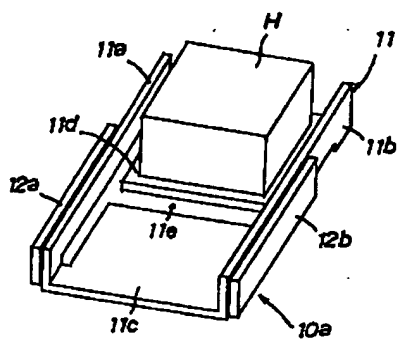
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

## DRAWINGS

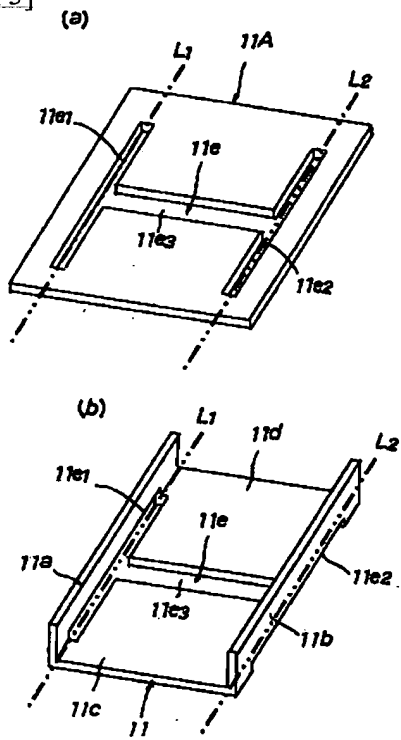
[Drawing 1]



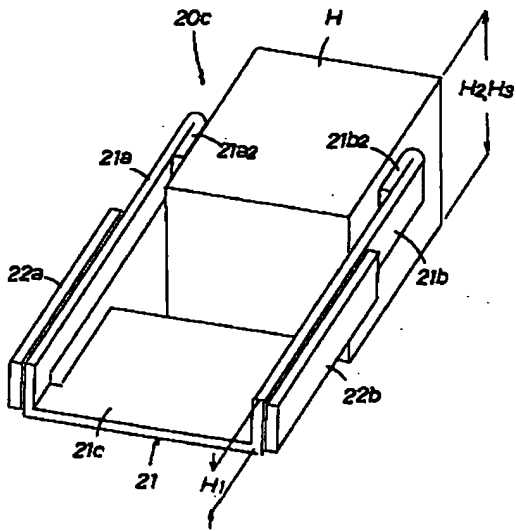
[Drawing 2]



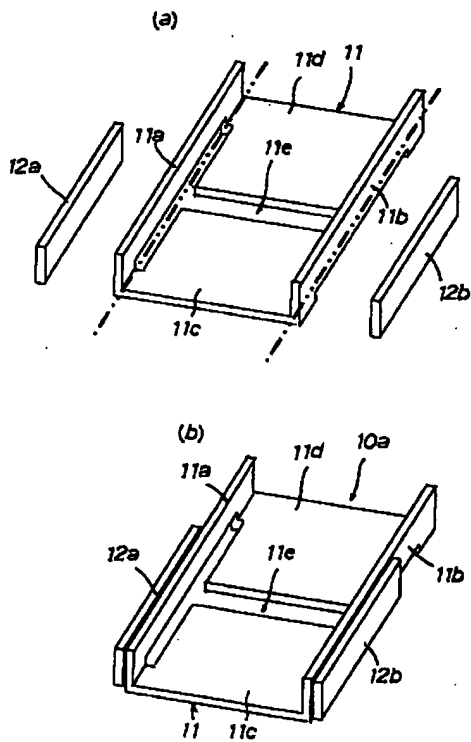
[Drawing 3]



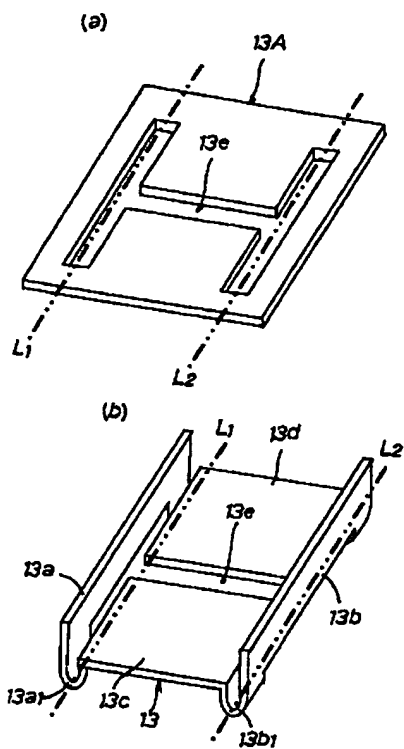
[Drawing 19]



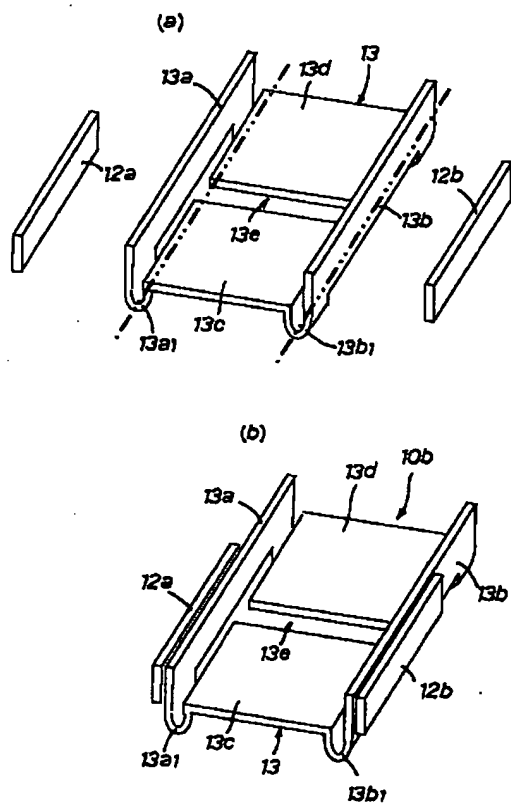
[Drawing 4]



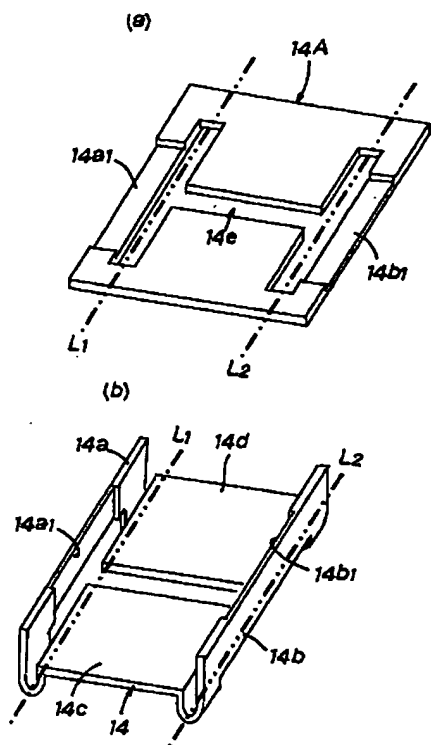
[Drawing 5]



[Drawing 6]

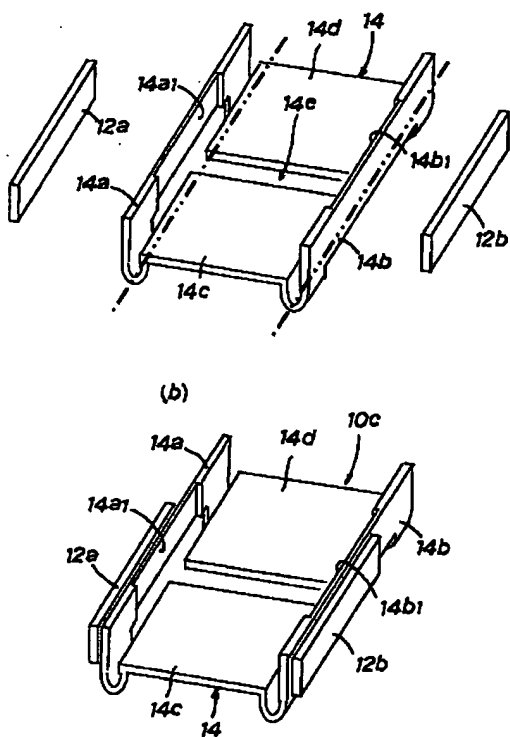


[Drawing 7]



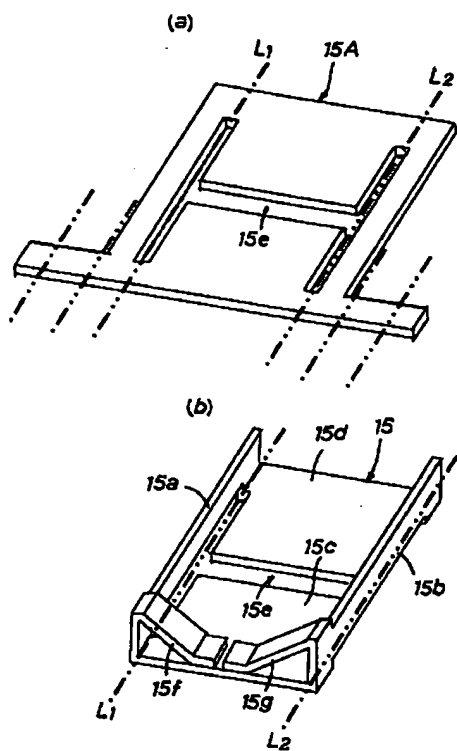
[Drawing 8]

(a)

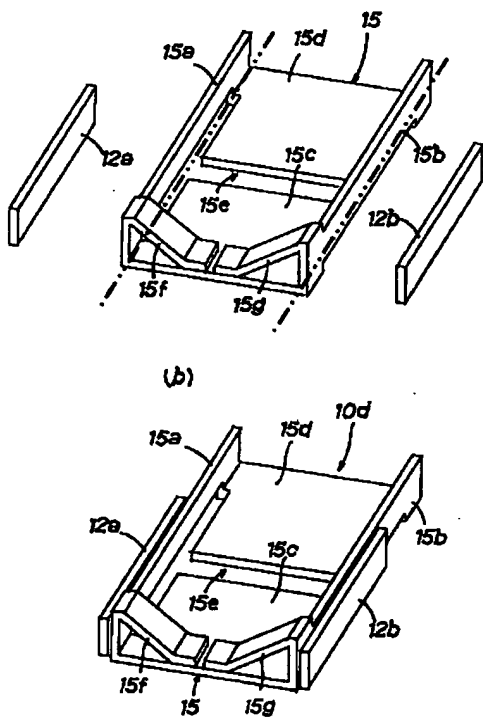


[Drawing 9]

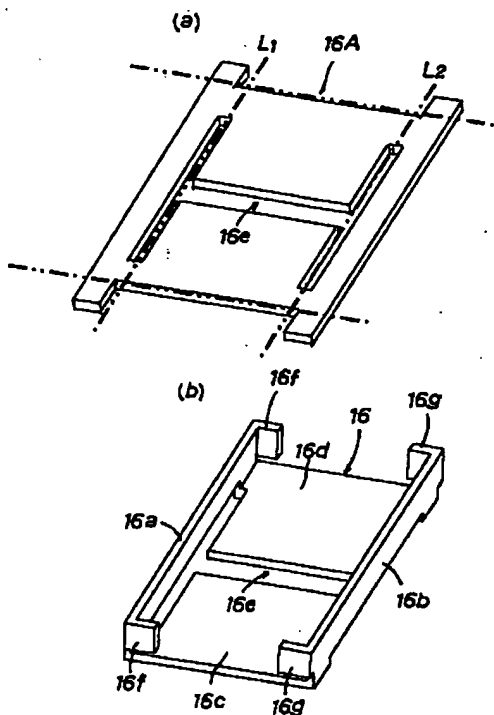
(b)



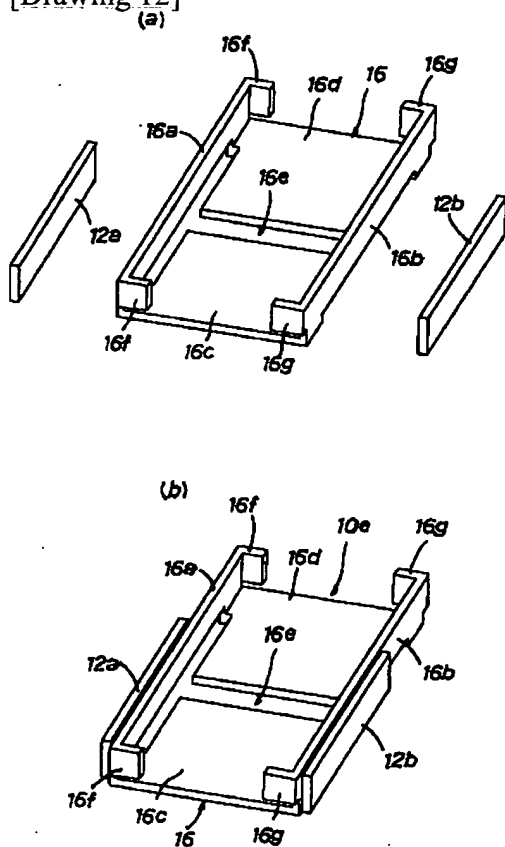
[Drawing 10]  
(a)



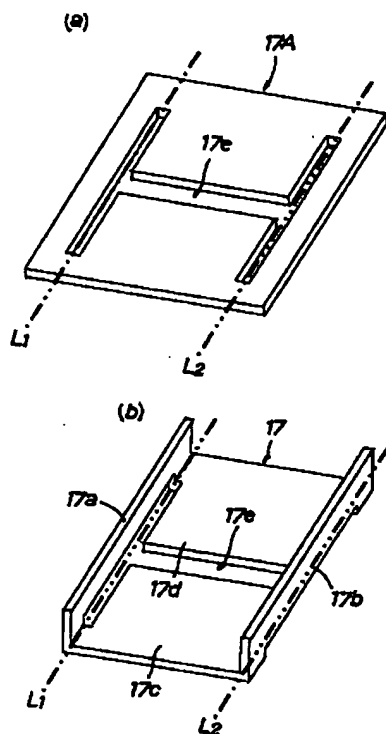
[Drawing 11]



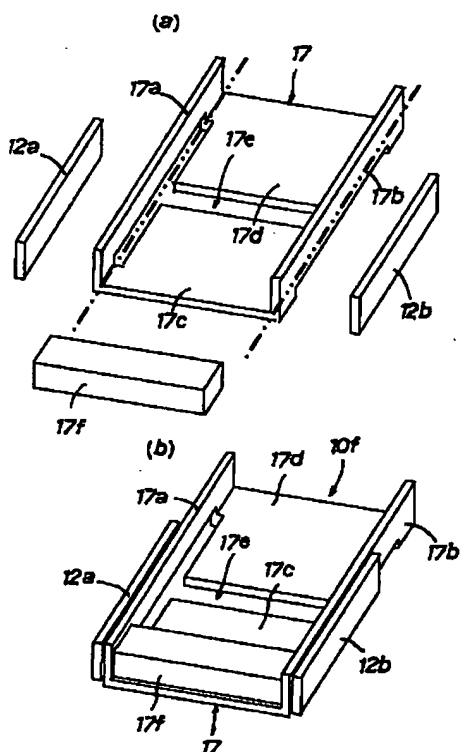
[Drawing 12]



[Drawing 13]

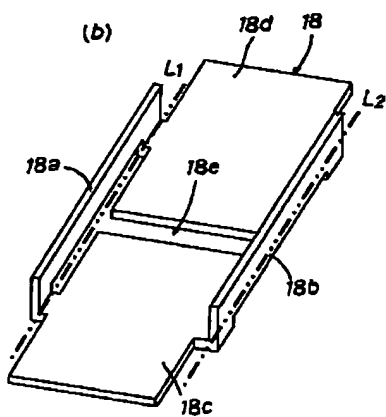
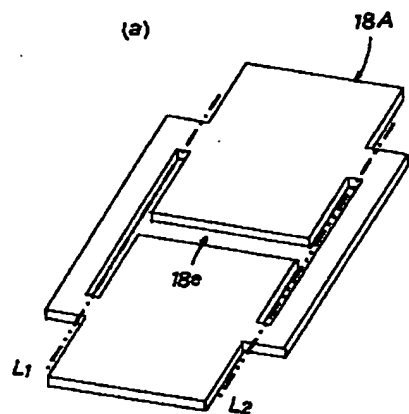


[Drawing 14]

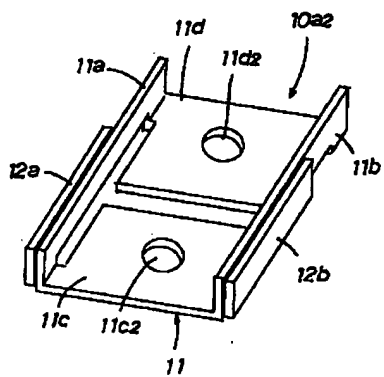


[Drawing 15]

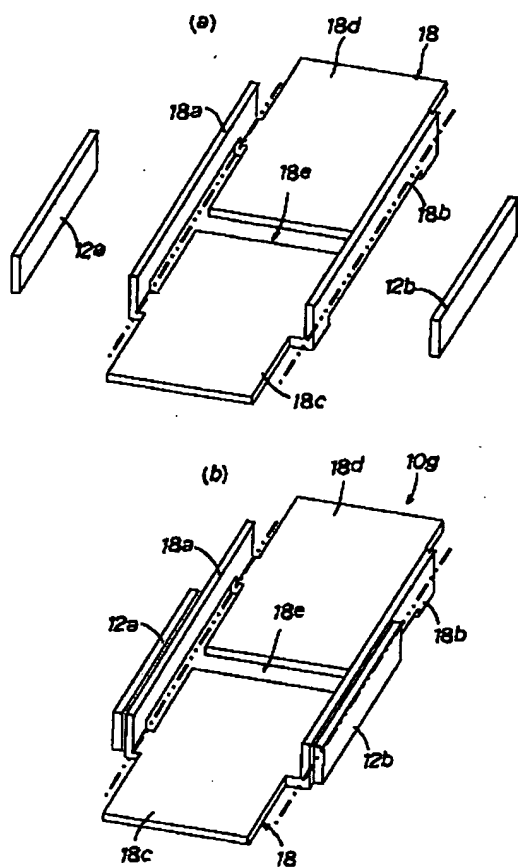




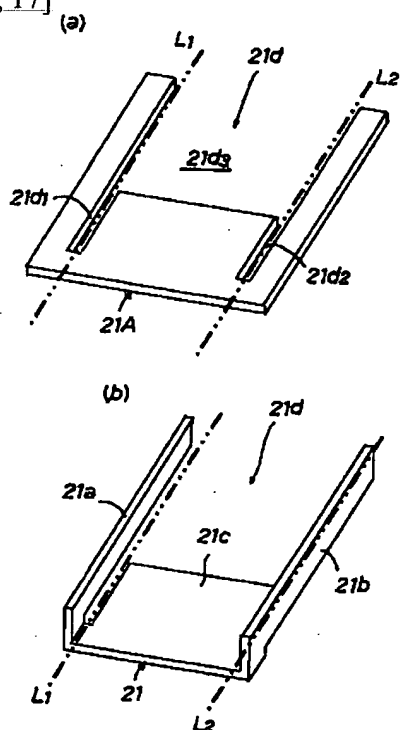
[Drawing 30]



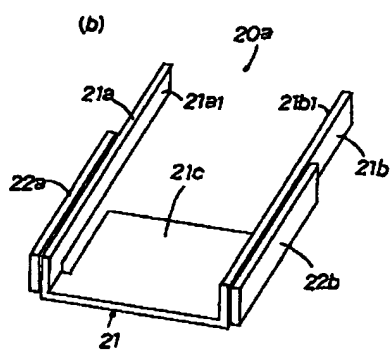
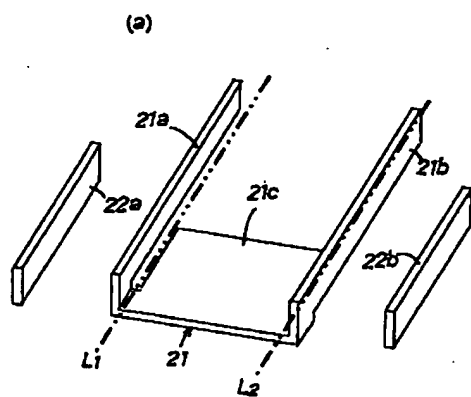
[Drawing 16]



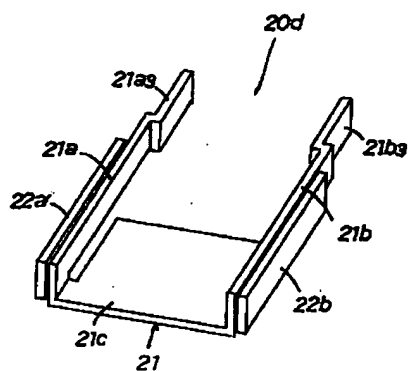
[Drawing 17]



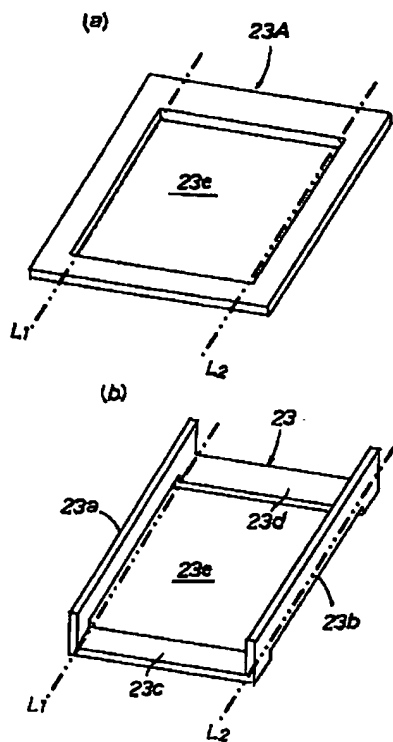
[Drawing 18]



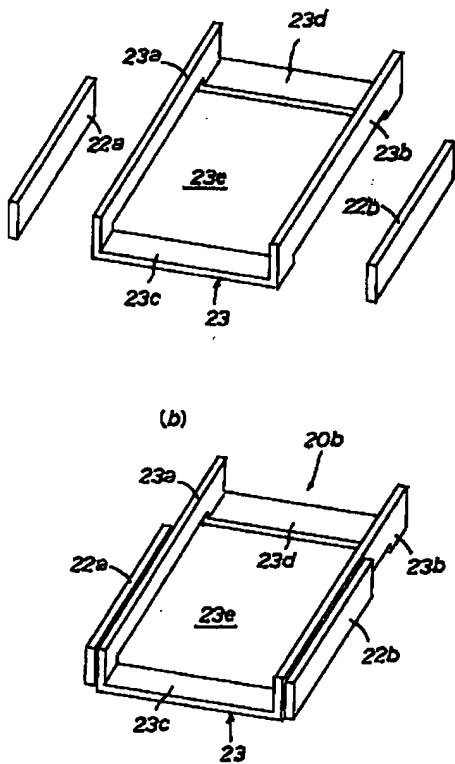
[Drawing 20]



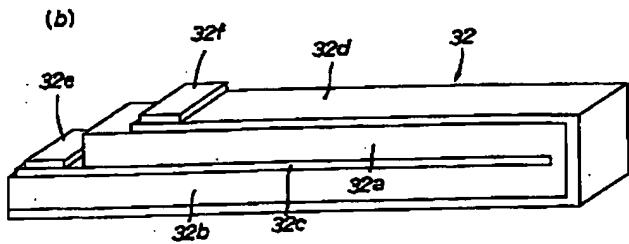
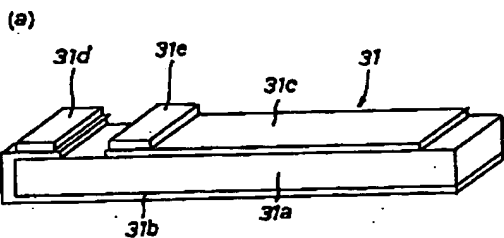
[Drawing 21]



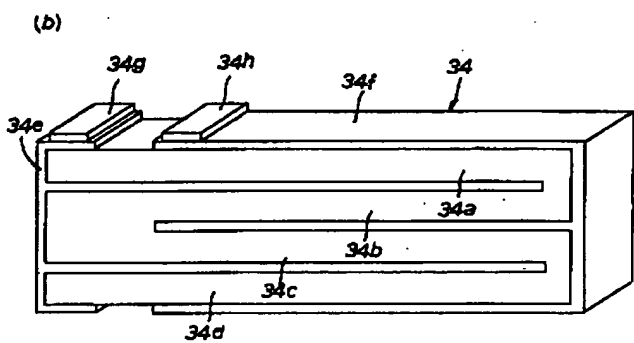
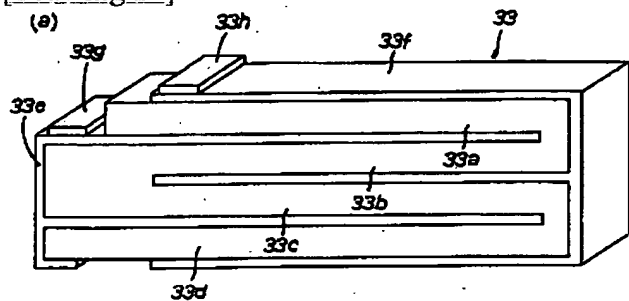
[Drawing 22]  
(a)



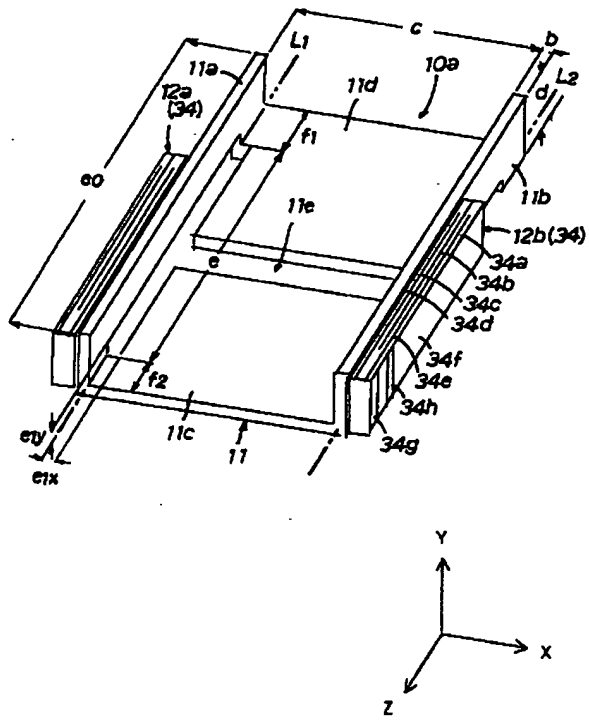
[Drawing 23]



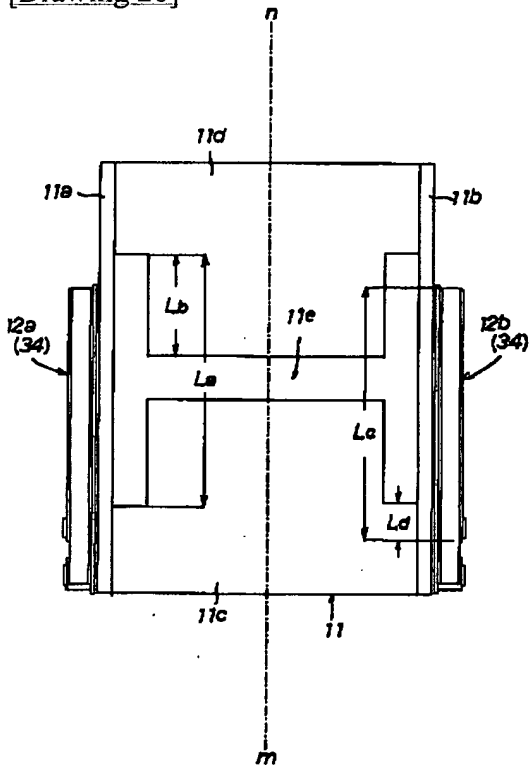
[Drawing 24]



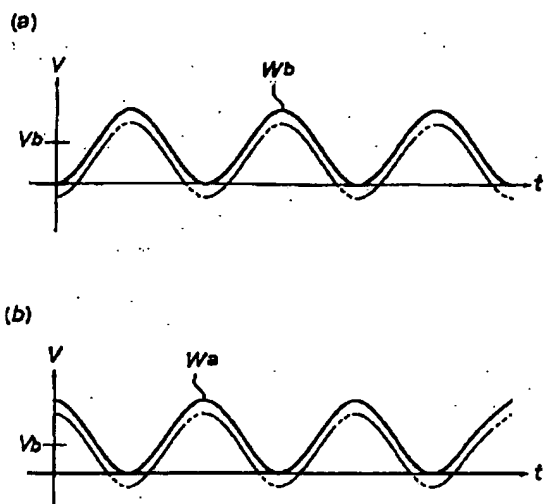
[Drawing 25]



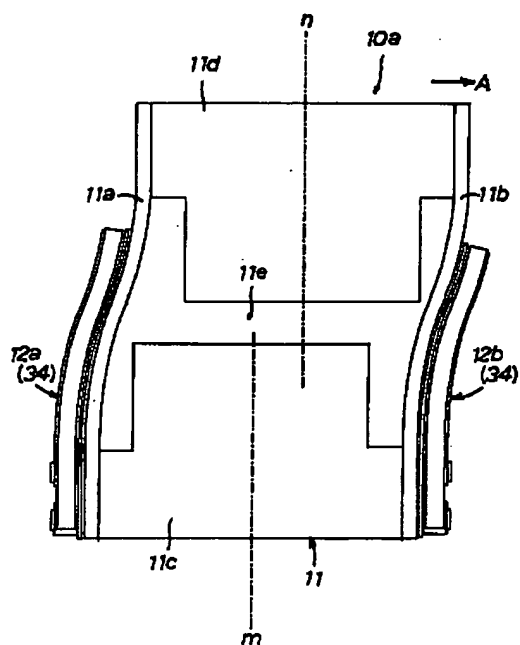
[Drawing 26]



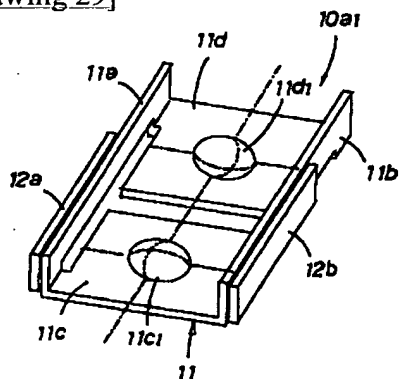
[Drawing 27]



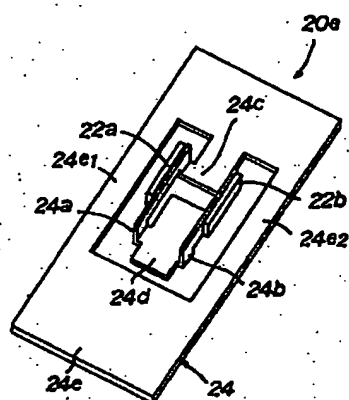
[Drawing 28]



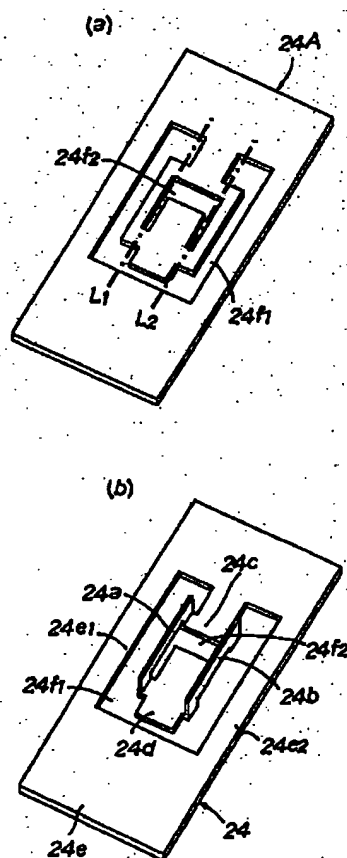
[Drawing 29]



[Drawing 31]

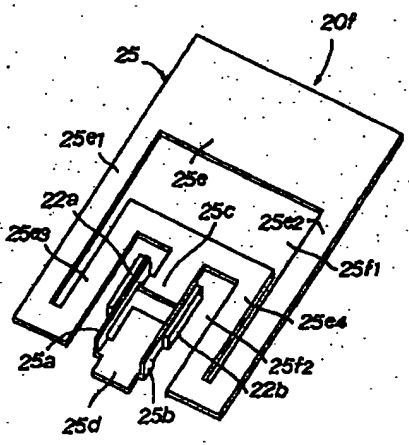


[Drawing 32]

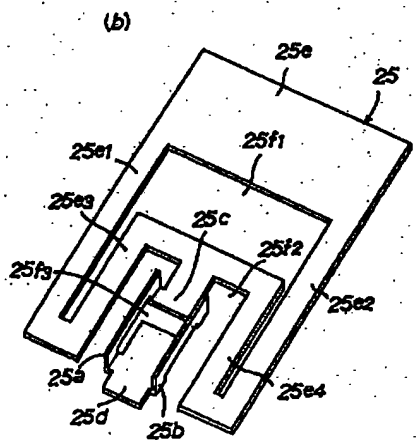
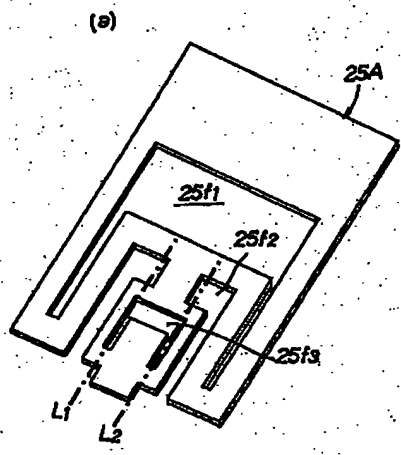


[Drawing 33]

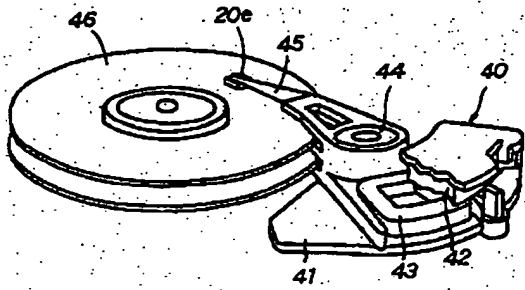




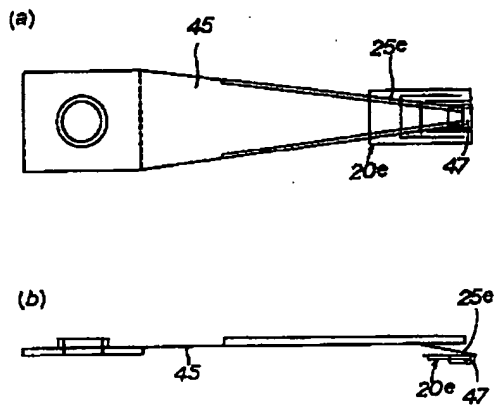
[Drawing 34]



[Drawing 35]



[Drawing 36]



[Translation done.]